# SYSTEM PERFORMANCE REPORT

## 2021

MARICOPA
ASSOCIATION of
GOVERNMENTS

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## List of Acronyms

ADOT – Arizona Department of Transportation
ALISS – Accident Locator Surveillance System
CATT Lab – The Center for Advanced Transportation Technology Laboratory
CMP – Congestion Management Process
DRCOG – Denver Regional Council of Governments
FAST Act – Fixing America's Surface Transportation Act
FHWA – Federal Highway Administration
FMS – Freeway Monitoring System
FTA – Federal Transit Administration
H-GAC – Houston-Galveston Area Council
HSIP – Highway Safety Improvement Plan
ITS – Intelligent Transportation Systems
MAG – Maricopa Association of Governments
MAP-21 – Moving Ahead for Progress in the 21st Century
MPO – Metropolitan Planning Organization
NCTOG – North Central Texas Council of Governments
NHS – National Highway System
PTASP – Public Transportation Agency Safety Plan
RITIS – Regional Integrated Transportation Information System
RTP – Regional Transportation Plan
SACOG – Sacramento Area Council of Governments
SCAG – Southern California Association of Governments
SEPTA – Southeastern Pennsylvania Transportation Authority
SOV – Single Occupancy Vehicle
TAM – Transit Asset Management
TCQSM – Transit Capacity and Quality of Service Manual
TIP – Transportation Improvement Program
TTI – Texas A&M Transportation Institute
TTR – Travel Time Reliability
TTTR – Truck Travel Time Reliability
TxDOT – Texas Department of Transportation
VMT – Vehicle Miles Traveled

# Executive Summary

## Regional Overview
### Our Changing Transportation Landscape

**How we get around.**
The number of people using our transportation system continues to grow as our region expands. As we continue to put stress on our existing infrastructure, creative and efficient methods of moving people around the Valley will be essential.

**129 million**
Vehicle Miles Traveled in 2020

**52 million**
Transit Riders in FY2020

**Freeway Pavement Condition**

**23.8%**
Non-SOV Travel

**What does this mean?**
Non-SOV stands for Non-Single Occupancy Vehicle. The percentage to the left represents the number of trips in our region that were taken using public transportation, carpool, vanpool, telecommuting, walking, or bicycling.

Good — 54%

**Pavement Condition**
ADOT routinely collects pavement conditions on the freeways and highways in Arizona. Pavement condition can negatively impact the wear and tear on our vehicles and even our MPGs. This chart provides a snapshot of the pavement condition on our regional freeways and highways

Fair — 34%

Poor — 12%

**Loop 202 (South Mountain)**
In December 2019, the final section of Loop 202 opened for traffic. A year of data would be required for a thorough analysis. The pandemic has made data collected in 2020 unsuitable for this purpose.

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**Data Sources:** HERE Traffic Data, MAG Travel Demand Model, Valley Metro Performance Reports

# Travelling in a Pandemic
## A Year Unlike Any Other

### COVID-19's Impact on Regional Traffic

Telecommuting and stay-at-home restrictions for the COVID-19 pandemic had a noticeable impact on traffic. The Maricopa Association of Governments has been tracking the amount of time commuters are stuck in traffic on a daily basis. The measure of congestion delay is calculated from speed data, which covers all major freeways and most of the arterial streets in Maricopa County.

Fewer cars on the road means less congestion, which means higher average speeds. An interesting phenomenon from the pandemic is the return of traffic volumes to nearly pre-pandemic levels, while a similar return of congestion levels has not been observed.

**March 2020**
Congestion Drops Sharply

**September 2020**
Congestion Slowly Begins Increasing

**May 2021**
50% of "Normal" Congestion Delay
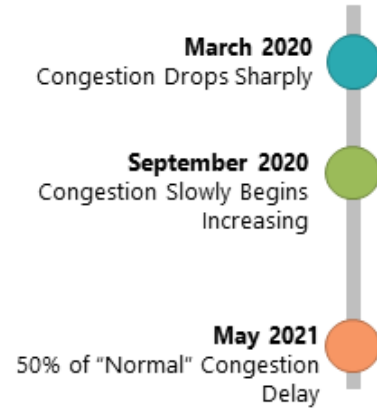
### When comparing 2020 data to 2019, we find:

**7%** increase
AM & PM Freeway Speeds

**8%** increase
AM Arterial Speeds

**9%** increase
PM Arterial Speeds

### What About Freight?

COVID-19 hasn't stopped freight deliveries. Unlike commute traffic, daily traffic for heavy trucks has stayed consistent. After heavy truck volumes showed a modest drop during the 2nd week of April 2020, heavy truck volumes rebounded and remained steady since May of 2020.

## Average Weekday Traffic Volume*

*March 2020*

100%

*Mid-March 2021*
**Traffic Volumes Return to Normal**

*Mid-April 2020*
**Lowest Traffic Volumes**

50%
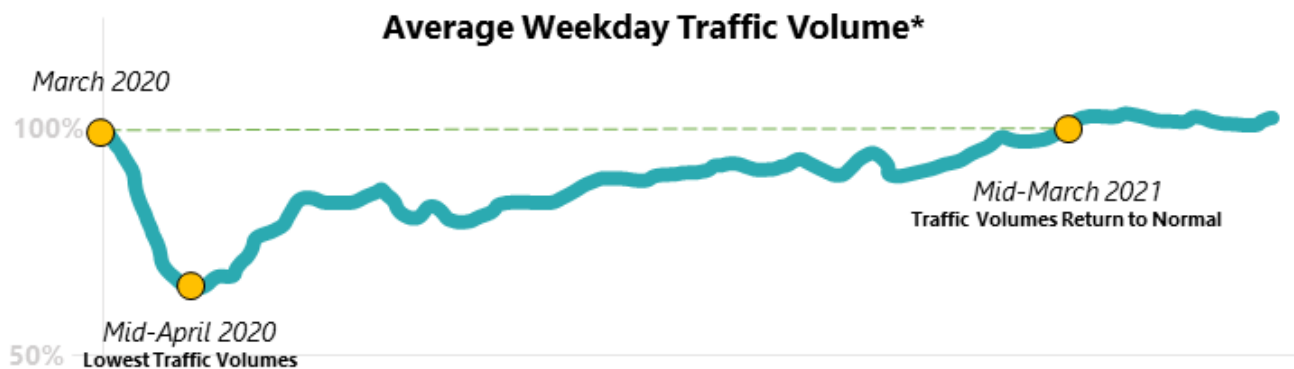
**Data Sources:** INRIX, ADOT Automated Traffic Counters

*Traffic volume data is obtained from a limited number of locations and may not be reflective of traffic trends in all areas of the region.*

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# Travelling in a Pandemic
## COVID-19 and Congestion

**Traffic Volume vs. Traffic Congestion**

Why do we see less congestion on the regional freeway system even though overall traffic volumes have returned to pre-COVID numbers? We have a similar amount of vehicles on the roads, but we do not experience as much delay as we used to before the pandemic. There are several reasons for this phenomenon. Major infrastructure improvements and road widening projects were accelerated during the pandemic and have reduced travel delay. Regional travel patterns have also changed noticeably due to increased telecommuting, changing land uses and different socioeconomic behaviors, including an increase in online shopping and entertainment.

**What About Other Regions?**

Compared to other regions across the country, congestion on our freeways is returning here at a slower pace. It is unlikely that there is a single definitive reason for this phenomenon and more likely due to a confluence of factors that may include:  expanded flexibility in work hours, redundancies built into our network, regional telecommute policies, and recent infrastructure improvements.

## Freeway Congestion Recovery
### Greater Phoenix Region vs. Other Regions



Legend: Other Regions — Greater Phoenix Region
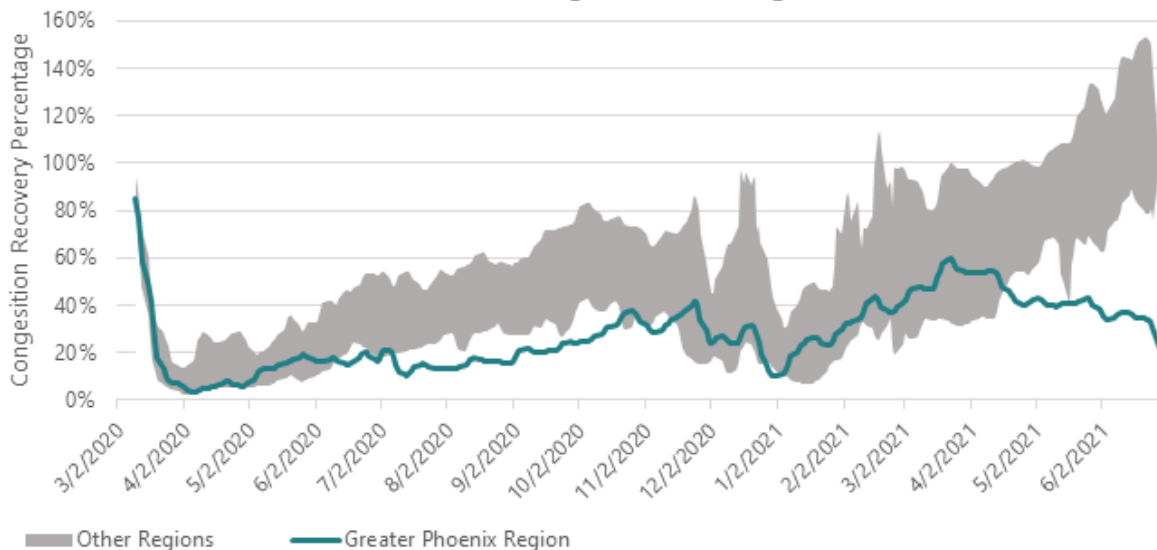
**Is This a Permanent Change?**

It is too soon to tell if these changes to our regional traffic patterns are permanent. MAG regularly collects data on both arterials and freeways and will be closely monitoring how the region is responding to changing conditions.

**As of June 2021,** the data shows a:

**40%** reduction
In Afternoon Congestion

**60%** reduction
In Morning Congestion

**Data Sources:** INRIX, ADOT Automated Traffic Counters

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INRIX    ATT

# Introduction

## Transportation Performance Program

In order to make better, more data-driven decisions, MAG's Transportation Performance Program continues to fulfill two main functions:

1. To meet federal requirements for performance measurement.

2. To assist MAG in project evaluation and prioritization.

The first item requires collaboration with our transportation partners and is guided by a variety of federal statutes outlined in Appendix A. The most notable being the Fixing America's Surface Transportation Act (FAST Act). The second requires coordination with our member agencies and many divisions within MAG. Both elements require large datasets and a comprehensive understanding of their use and limitations. Background on the datasets used by the Transportation Performance Program can be found in Appendix B – Transportation Performance Data & Sources.

MAG's performance measurement program began in earnest in 2008 with the development of the Performance Measurement Framework and Congestion Management Update Study. Prior to that, performance activities were still conducted, though in a less formalized fashion. A comprehensive history of performance measures at MAG can be found in Appendix C – History of Performance Measures at MAG.

## The System Performance Report

The goal of this document is to provide a brief report on the performance of the existing transportation system within the MAG region. Information will be provided at multiple scales and for various modes to provide a holistic picture of transportation. The intention is to be practical and comprehensive while focusing on the larger transportation picture.

# System-Level Performance

## Federal Performance Targets

The current federal performance targets focus solely on metrics at the system -level. Three groups of transportation performance measures and two transit-specific measures have been mandated. With each roadway-specific performance measure, a metropolitan planning organization (MPO) can decide to support the targets set by the state or they can elect to develop their own. MAG has elected to calculate some targets, specific to the MAG planning area, and support other statewide targets as noted below. For the transit-specific measures, the MPO can elect to support the targets of its providers or develop regional targets.

### PM1 – Safety Performance Targets

The Arizona Department of Transportation (ADOT) is required to submit established safety targets with their annual Highway Safety Improvement Program (HSIP) report to the Federal Highway Administration (FHWA). On August 31, 2012, ADOT formally established safety targets for the state of Arizona for 2021. These safety targets are based on the Safety Performance Measures established by the FHWA Safety Performance Management final ruling and are based on five-year rolling averages.

The data below is compiled by ADOT. Each year ADOT presents this information to MAG's policy committees. The committees must decide whether to support the state targets or develop MAG-specific projections. To date, MAG has elected to support ADOT's statewide targets.

Safety targets established by ADOT are as follows:

#### S1: Number of Fatalities

The declining number of vehicle miles traveled (VMT) during The Great Recession from 2007 to 2009 resulted in a likewise decline in the number of fatalities statewide. As VMT steadily rose, the number of fatalities also increased as shown in Chart 1.

## Annual Fatalities and 5-Year Rolling Average

Chart showing annual fatalities (purple bars) and 5-year rolling average (green line) for years 2005–2022.

5-Year Avg. Fatality (green line values): 1,133 (2005), 1,182 (2006), 1,170 (2007), 1,132 (2008), 1,062 (2009), 975 (2010), 880 (2011), 830 (2012), 812 (2013), 806 (2014), 834 (2015), 859 (2016), 894 (2017), 926 (2018), 968 (2019), 981 (2020), 985 (2021), 982 (2022)

Fatalities (purple bar values): 1193 (2005), 1301 (2006), 1071 (2007), 938 (2008), 806 (2009), 759 (2010), 827 (2011), 821 (2012), 849 (2013), 774 (2014), 897 (2015), 952 (2016), 998 (2017), 1011 (2018), 982 (2019), 962.4 (2020), 972 (2021), 981.7 (2022)

Legend: ■ Fatalities  ◆ 5-Year Avg. Fatality

*Chart 1 - Actual and Projected Number of Fatalities 2005-2022. Source: ADOT*

*S2: Fatalities per 100 Million VMT*

Using a rate rather than the absolute number allows us to take into consideration the population growth our region has experienced.

## Annual Fatality Rate and 5-Year Rolling Average

Chart showing annual fatality rate (purple bars) and 5-year rolling average (green line) for years 2005–2022.

5-Year Avg. Fatality Rate (green line values): 2.08 (2005), 2.07 (2006), 1.98 (2007), 1.86 (2008), 1.73 (2009), 1.58 (2010), 1.44 (2011), 1.38 (2012), 1.35 (2013), 1.33 (2014), 1.35 (2015), 1.37 (2016), 1.40 (2017), 1.43 (2018), 1.46 (2019), 1.45 (2020), 1.43 (2021), 1.39 (2022)

Annual Fatality Rate (purple bar values): 2.00 (2005), 2.08 (2006), 1.70 (2007), 1.52 (2008), 1.34 (2009), 1.27 (2010), 1.39 (2011), 1.37 (2012), 1.40 (2013), 1.24 (2014), 1.38 (2015), 1.45 (2016), 1.53 (2017), 1.53 (2018), 1.40 (2019), 1.35 (2020), 1.35 (2021), 1.35 (2022)

Legend: ◆ 5-Year Avg. Fatality Rate  ■ Annual Fatality Rate

*Chart 2 - Actual and Projected Rate of Fatalities 2005-2022. Source: ADOT*

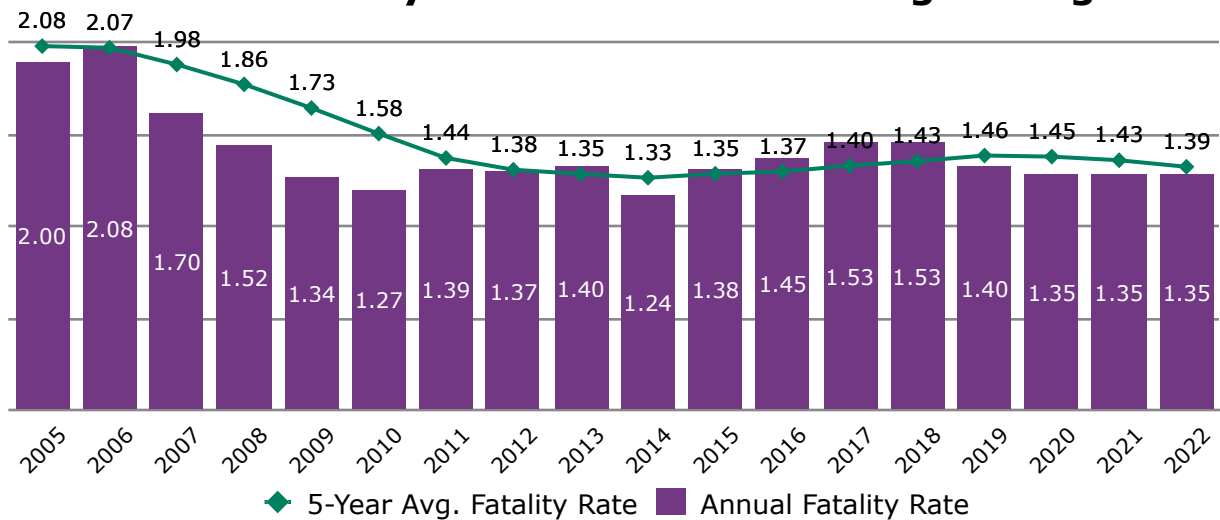*S3: Number of Serious Injuries*

## Annual Serious Injuries and 5-Year Rolling Average
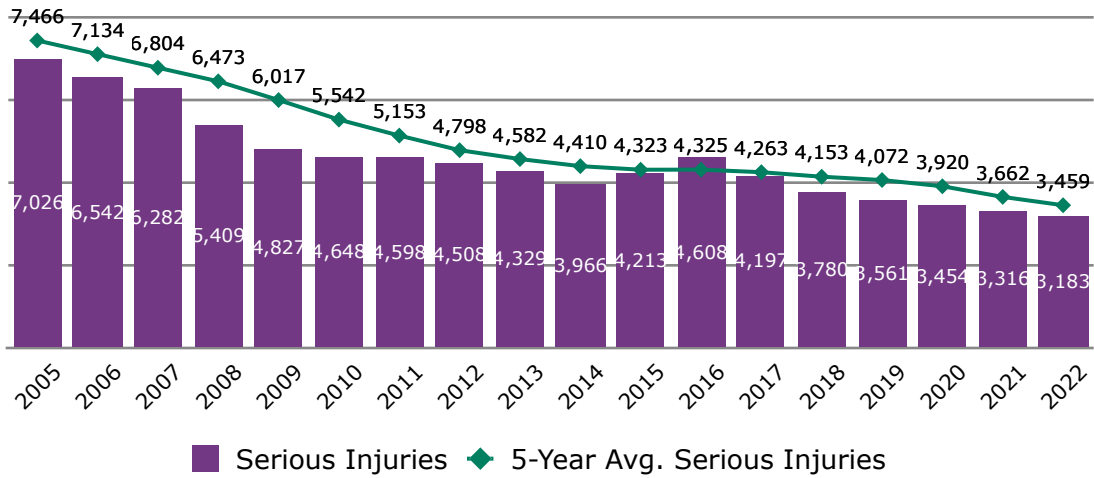


*Chart 3 - Actual and Projected Number of Serious Injuries 2005-2022. Source: ADOT*

Visit FHWA for more information about the definition of "serious injury".

*S4: Serious Injuries per 100 Million VMT*

As with fatalities, using rate rather than absolute numbers helps account for population growth.

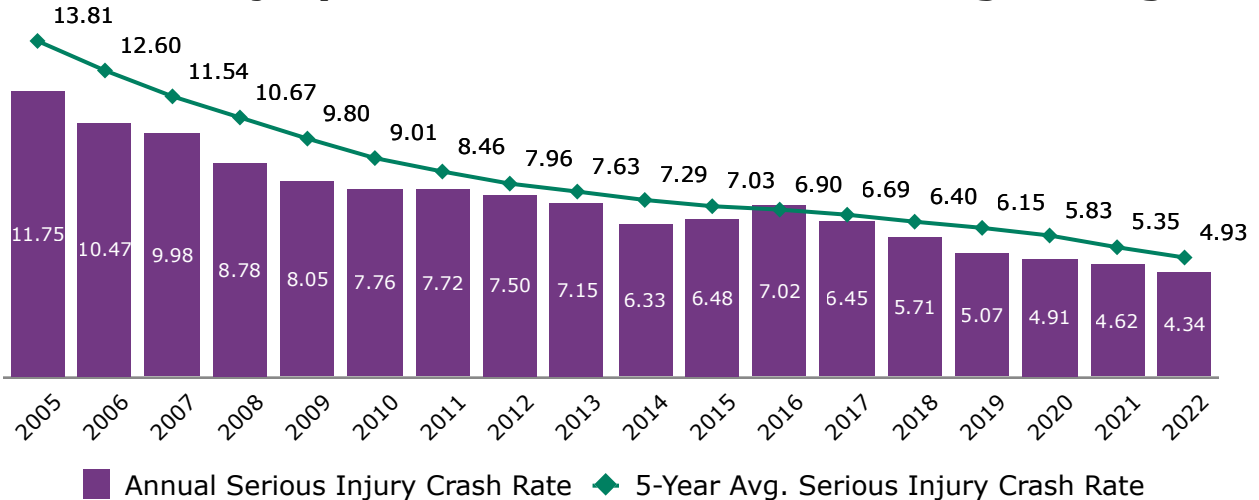## Serious Injury Crash Rate and 5-Year Rolling Average



*Chart 4 - Actual and Projected Rate of Serious Injuries 2005-2022. Source: ADOT*

*S5: Number of Non-motorized Fatalities and Non-motorized Serious Injuries*

Reducing non-motorized fatalities is a high priority for both the state and the MAG region. A recent report from the Governor's Highway Safety Association placed Arizona as the fifth-worst state in the nation for pedestrian deaths[1].

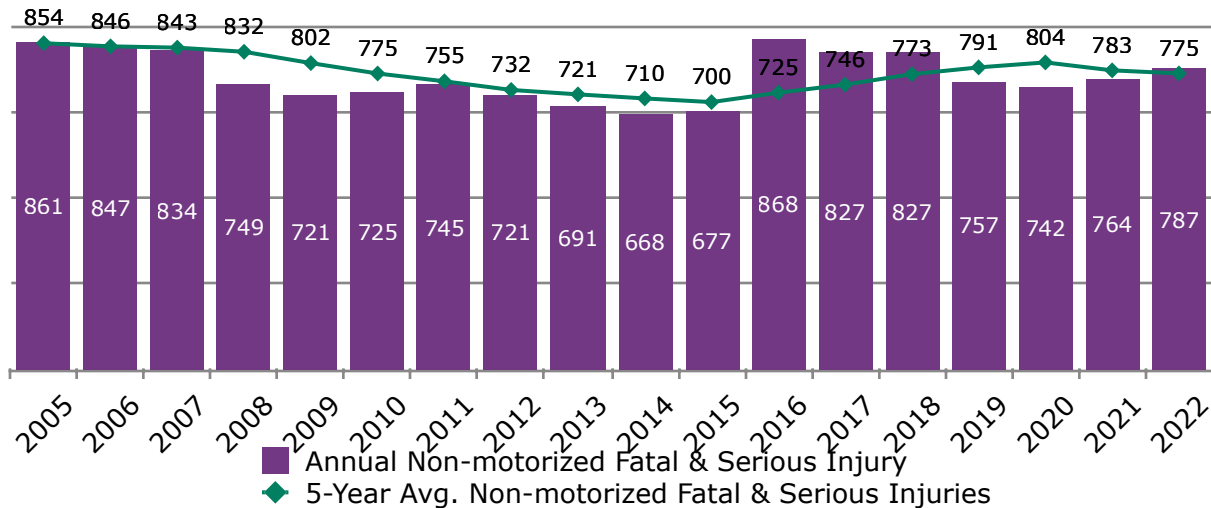## Annual Non-motorized Fatalities and Serious Injuries and 5-Year Rolling Average



*Chart 5 - Actual and Projected Number of Non-motorized Fatalities & Serious Injuries 2005-2022. Source: ADOT*

[More information on safety efforts can be found on MAG's Safety Programs webpage](#).

*Target Setting*

The safety targets set by ADOT are data-driven and realistic. They are intended to keep the state focused on improving safety while still striving for the goals of the MPOs' regional Strategic Transportation Safety Plans and the State Strategic Traffic Safety Plan of reducing the number of traffic fatalities and serious injury crashes in Arizona.

MPOs are required within 180 days of the effective date to indicate to ADOT whether the MPO supports the State target or will identify their own targets. MPOs can adopt the safety targets in perpetuity, or until the MPO should deem it necessary to establish and adopt their own targets. Since the state-established targets are closely tied to the ADOT administered federal aid HSIP, and MPO targets are not included in the assessment of whether a state met or made significant progress toward meeting its targets, ADOT recommends that MPOs support the state targets.

MAG is committed to doing the following:

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[1] https://www.ghsa.org/sites/default/files/2019-02/FINAL_Pedestrians19.pdf Accessed 1/30/2020.

- Continue to administer the newly established MAG Roadway Safety Program to fund low-cost safety improvements as a supplement to the state's HSIP. This new funding program provides local agencies the flexibility to implement near-term safety improvements in an expedited manner.

- Work with the state and safety stakeholders to address areas of concern for fatalities or serious injuries within the metropolitan planning area.

- Coordinate with the state and include the safety performance measures and HSIP targets for all public roads in the metropolitan area in the Regional Transportation Plan (RTP).

- Integrate into the metropolitan transportation planning process the safety goals, objectives, performance measures, and targets described in state safety transportation plans and processes such as applicable portions of the HSIP, including the State Strategic Traffic Safety Plan.

- Include a description in the Transportation Improvement Program (TIP) of the anticipated effect of the TIP toward achieving HSIP targets in the RTP, linking investment priorities in the TIP to those safety targets.

## PM2 – Bridge and Pavement Condition

The second set of performance measures required the establishment of pavement and bridge condition targets for the Interstate and non-Interstate National Highway System (NHS). Targets were established by ADOT in May 2018 and communicated to MPOs at that time. The official reporting date to FHWA was October 1, 2018. The first opportunity to revise the 4-year targets was October 1, 2020. At that time, ADOT formally notified MAG of its intent to amend two of its 4-year targets related to pavement condition during the mid-performance period:

- Percent of Interstate Pavements in Good Condition: 44 percent (changed from 48 percent)

- Percent of non-Interstate NHS Pavements in Good Condition: 28 percent (changed from 31 percent)

MAG supported the previous 4-year targets related to pavements in good condition on the Interstate and non-Interstate NHS and reaffirmed that support for the amended targets established by ADOT through its committee process.
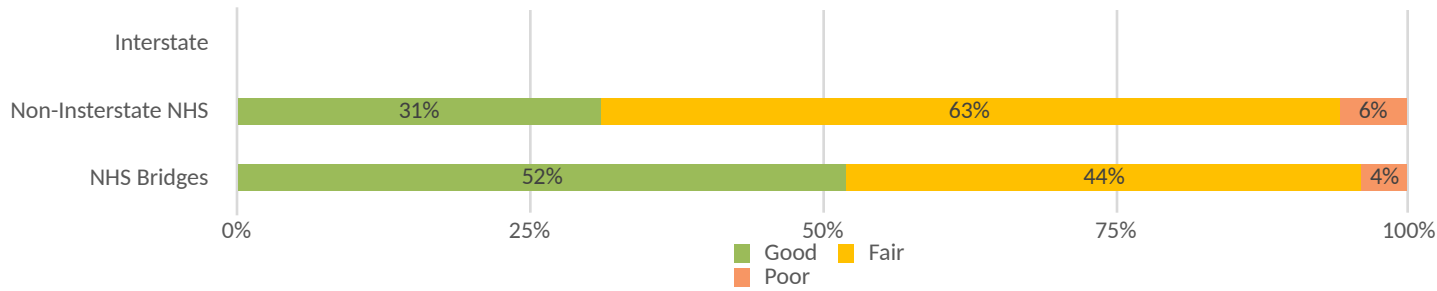
## 2-year Bridge and Pavement Condition Targets



**Chart 6-** *2-year Bridge and Pavement Condition Targets. Source: ADOT*

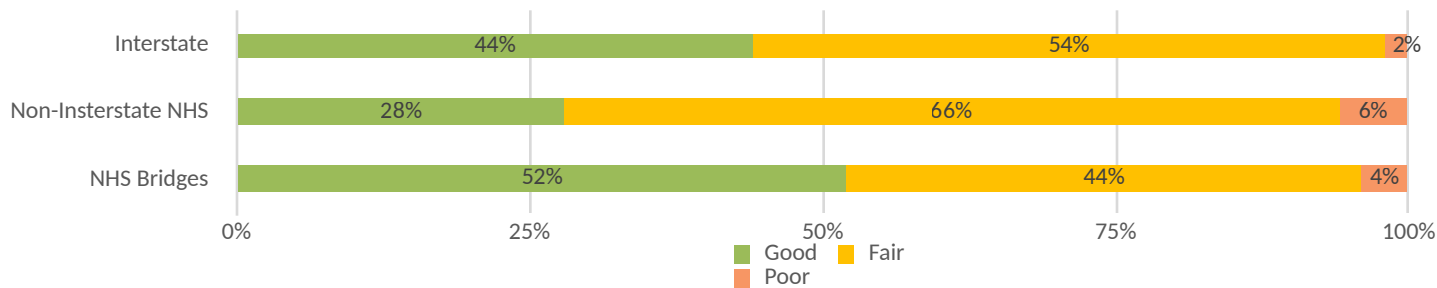## 4-year Bridge and Pavement Condition Targets



**Chart 7** - *4-year Bridge and Pavement Condition Targets. Source: ADOT*

To provide some context, MAG's NHS roadways represent 16 percent of the total non-Interstate NHS roadway lane miles in the state and MAG's bridge deck area is 3.1 percent of the total state NHS bridge deck area.

## PM3 – System Reliability

In collaboration with ADOT, MAG's Transportation and Environmental Divisions developed methodology for and calculated several reliability and emission measures as part of PM3.

| Measure | 2-Year Target | 4-Year Target | 2-Year Target | 4-Year Target |
|---|---|---|---|---|
| Travel Time Reliability - Interstate System | 85.83% | 85.70% | 67.84% | 64.28% |
| Travel Time Reliability - Non-Interstate NHS | 79.22% | 74.90% | 69.95% | 61.11% |
| Truck Travel Time Reliability Index | 1.2 | 1.35 | 1.47 | 1.70 |
| Peak Hour Excessive Delay Per Capita | 8.8 Hours | 10.9 Hours | 8.8 Hours | 10.9 Hours |
| % Non-SOV Travel | 22.90% | 22.60% | 22.90% | 22.60% |

*Table 1 - System Reliability Measures 2-year & 4-year Targets. Source: MAG & ADOT*

The targets above speak to the reliability of our transportation system. Each measure speaks to a different facet of transportation:

- Travel Time Reliability (TTR) – This target represents the percentage of miles that are reliable. Reliability measures the variability of observed travel times on a roadway segment. The less variability, the more reliable a roadway segment is. Incidents, weather events, and congestion can play a large part greatly influence in the level of reliability one can expect.

- Truck Travel Time Reliability (TTTR) – Produced from the National Performance Management Research Data Set, this target addresses the reliability of travel time for trucks on the Interstate system.

- Peak Hour Excessive Delay Per Capita – this target is measured by the annual hours of excessive delay per capita on the NHS.

- Percent of Non-Single Occupancy Vehicle (SOV) Travel – This percentage is taken from the American Community Survey commuting data.

Visit FHWA for more information about the calculations above.

Unlike PM1 and PM2, MAG has set specific targets for our region. Our analysis showed the statewide numbers for the three reliability measures were not representative of the conditions within the MAG region. As a results MAG-specific targets were used.

For the On-Road Mobile Source Emissions Reduction Measure, PM3 also requires the establishment of emissions reduction targets for Congestion Mitigation and Air Quality Improvement Program funded projects. These targets were developed by MAG's Environmental Division and supported by MAG's policy committees. In the table below the targets for reducing Volatile Organic Compounds (VOC), Carbon Monoxide (CO), Nitrogen Oxide (NOx), Particulate Matter that is 10 microns or less (PM-10), and Particulate Matter that is 2.5 microns or less (PM-2.5) are displayed.

| Emission Reduction Targets (kg/day) | VOC | CO | NOx | PM-10 | PM-2.5 |
|---|---|---|---|---|---|
| 2-Year Target (FY2018-2019) | 210 | 3,720 | 418 | 873 | 69 |
| 4-Year Target (FY2018-2021) | 385 | 6,985 | 761 | 1,399 | 112 |

*Table 2 - Air Quality and Emission 2-year & 4-year Targets. Source: MAG*

For more information on MAG's emission reduction efforts, please visit MAG's Environmental Division.

The opportunity to revise 4-year targets in this performance measurement category was also available in 2020. ADOT formally notified the MAG of its intent to amend its 4-year TTTR target during the mid-performance period. MAG had previously established its own target for this metric and following a comprehensive analysis, determined an amendment to its 4-year target was also warranted. The changes were approved through MAG's committee process and are reflected in the tables above.

## Transit Asset Management (TAM)

Since 2018, transit providers who receive Chapter 53 federal funds are required to create a Transit Asset Management plan. The goal of a TAM plan is to help agencies manage their assets operationally and financially.

There are two tiers of providers with different reporting requirements. Tier I providers represent a transit provider with more than 100 vehicles in their fleet. For 2020, three agencies in the MAG region meet that threshold: Valley Metro, the City of Phoenix, and the City of Tempe. Other agencies providing transit, but below that threshold, are known as Tier II providers. Tier II providers may be covered under the state TAM plan.

To address the requirement that MPOs must develop regionwide TAM targets, MAG has established a working group comprised of the Tier I agencies to coordinate TAM on a biannual basis. The TAM targets are taken through MAG's committee process for approval each year. The latest TAM targets, approved by MAG's Regional Council on January 27, 2021, are below.

| Rolling Stock | | Valley Metro RPTA | Valley Metro Rail | City of Phoenix | City of Tempe |
|---|---|---|---|---|---|
| Category | Useful Life Benchmark | Percent of revenue vehicles that have met their useful life benchmark. | | | |
| Light Rail Vehicle | 31 years | N/A | 0% | N/A | N/A |
| Streetcar Rail | 31 years | N/A | 0% | N/A | N/A |
| Articulated Buses 60' | 14 years | 0% | N/A | 0% | 5% |
| Buses 40' | 14 years | N/A | N/A | 0% | 5% |
| Buses 40' and longer | 12 years | 5% | N/A | N/A | N/A |
| Cutaway Buses | 10 years | N/A | N/A | 0% | 5% |
| Medium Duty Buses <35' | 10 years | N/A | N/A | 0% | N/A |
| Van, Vanpool | 8 years | 7% | N/A | 0% | N/A |
| Dedicated Paratransit Vehicles | 8 years | 0% | N/A | 0% | N/A |
| Bus 30-35' | 7 years | 14% | N/A | 0% | 5% |

| Equipment | | | | | |
|---|---|---|---|---|---|
| Category | Useful Life Benchmark | Percent of service vehicles that have met their useful life benchmark. | | | |
| Equipment and non-revenue vehicles | 14 Years (trucks) | 24% | 1% | N/A | 10% |
| Equipment and non-revenue vehicles | 8 years (autos) | 67% | 20% | N/A | 10% |
| Support vehicles - auto | 8 years | N/A | N/A | 27% | N/A |
| Support vehicles - other rubber tire vehicle | 8 years | N/A | N/A | 42% | N/A |
| Support vehicles - minivan | 8 years | N/A | N/A | 0% | N/A |
| Support vehicles - sport utility van | 8 years | N/A | N/A | 3% | N/A |

| Facilities | | | | | |
|---|---|---|---|---|---|
| Category | Criteria | Percent of facilities rated below 3 on condition scale. | | | |
| Facilities | | 4% | 15% | N/A | 0% |
| Administration facility | Condition based | N/A | N/A | 0% | N/A |
| Maintenance facility | TERM[1] scale (1-5) | N/A | N/A | 0% | N/A |
| Transit center/passenger parking facility | | N/A | N/A | 0% | N/A |

| Infrastructure | | | | | |
|---|---|---|---|---|---|
| Category | Criteria | Percent of guideway under performance restriction. | | | |
| Guideway Performance | Performance restriction[2] | N/A | 1% | N/A | N/A |

[1]Transit Economic Rate Model

[2]The light rail vehicle must slow to less than its normal travelling speed.

*Table 3* - *Transit Asset Management Targets by Agency. Source: MAG*

For more information about TAM plans visit the United States Department of Transportation.

## Public Transportation Agency Safety Plans (PTASP)

On December 31, 2020, the first iterations of PTASP were due to the Federal Transit Administration (FTA). The plans must include safety performance targets set by transit providers. Furthermore, the plans must be updated and certified by the providers annually thereafter. Valley Metro and the City of Phoenix developed and approved their PTASPs through their respective committee processes. Like the TAM plans, the PTASP will be taken through MAG's committee process annually for committee approval.

For more information about PTASP visit the United States Department of Transportation.

## Comparative Analysis

To provide national context to MAG's performance measures, a comparative analysis was conducted using publicly available performance targets from peer MPOs. Only PM3 measures are compared in the analysis below as they are often, though not always, set by the MPO.

Alongside MAG, five peer agencies have been identified to compare PM3 measures and targets: North Central Texas Council of Governments (NCTCOG), Houston-Galveston Area Council (HGAC), Southern California Association of Governments (SCAG), Sacramento Area Council of Governments (SACOG), and Denver Regional Council of Governments (DRCOG). These peer agencies have been identified based on geographical proximity and demographic similarity.

Three of the MPOs, including MAG, elected to set PM3 targets for the region. Both NCTCOG and H-GAC set their own targets that differ from the statewide targets sent by the Texas Department of Transportation (TxDOT). According to H-GAC, TxDOT partnered with the Texas A&M Transportation Institute (TTI) to establish a statewide methodology and recommend future year targets for all MPOs within Texas. TTI calculated the base-year measurements from observed data and formulated targets for Texas MPOs, including H-GAC and NCTCOG. The other three MPOs, SCAG, SACOG, and DRCOG, all elected to follow their states' respective statewide targets, set by Caltrans and the Colorado Department of Transportation.

| Metropolitan Planning Organization | TTR-Interstate Baseline | TTR-Interstate 2 Year | TTR-Interstate 4 Year | Trend | Unified with State DOT? |
|---|---|---|---|---|---|
| MAG | 71.02% | 67.84% | 64.28% | Decrease | No |
| NCTCOG | 77.30% | 78.60% | 79.50% | Increase | No |
| H-GAC | 63.00% | 63.00% | 63.00% | Same | No |
| SCAG | 64.60% | 65.10% | 65.60% | Increase | Yes |
| SACOG | 64.60% | N/A | 65.60% | Increase | Yes |
| DRCOG | 80.70% | N/A | 81.00% | Increase | Yes |

*Table 4* - *TTR – Interstate. Source: Various, See Appendix D*

The TTR measure represents the percentage of miles that are reliable. Table 4 above reflects the TTR for Interstate miles. Incidents, weather events, and congestion can play a large part in the level of reliability one can expect. In comparison, MAG is the only MPO that has identified a negative trend in TTR on Interstate freeways. All other MPOs either show positive trends or no change in reliability. In context, the MAG region has significantly fewer Interstate miles compared to our peer MPOs. Additionally, both Interstate 10 and Interstate 17 form what is known as the "Spine Corridor" that stretches across the MAG region, primarily though Phoenix. The Spine Corridor is the most heavily travelled corridor

in the region and thus experiences heavy congestion. Other urban areas, notably the Los Angeles metropolitan area, have expanded their urban freeway systems primarily through Interstate construction.

| Metropolitan Planning Organization | TTR-non-Interstate NHS Baseline | TTR-non-Interstate NHS 2-Year | TTR-non-Interstate NHS 4-Year | Trend | Unified with State DOT? |
|---|---|---|---|---|---|
| MAG | 79.02% | 69.95% | 61.11% | Decrease | No |
| NCTCOG | 71.10% | N/A | 71.10% | Same | No |
| H-GAC | 73.00% | 73.00% | 73.00% | Same | No |
| SCAG | N/A | N/A | 74.00% | N/A | Yes |
| SACOG | N/A | N/A | 74.00% | N/A | Yes |
| DRCOG | 63.50% | N/A | 64.00% | Increase | Yes |

*Table 5* — *TTR - non-Interstate NHS. Source: Various, See Appendix D*

Similarly, Table 5 above shows TTR measures for non-Interstate roads that are a part of the NHS. These can include U.S. highways, state freeways and routes, and important regional arterials. MAG was the only MPO with a negative trend in TTR. Both Texas MPOs reported no change in reliability and DRCOG shows a positive trend. The California MPOs, SCAG and SACOG, did not have baseline or 2-year target data available and no trend was identified. Notably, MAG reports the highest baseline and the lowest 4-year target for this measure.

| Metropolitan Planning Organization | TTTR Index Baseline | TTTR Index 2-Year | TTTR Index 4-Year | Trend | Unified with State DOT? |
|---|---|---|---|---|---|
| MAG | 1.44 | 1.47 | 1.7 | Increase | No |
| NCTCOG | 1.74 | 1.71 | 1.9 | Increase | No |
| H-GAC | 2.1 | 2.1 | 2.1 | Same | No |
| SCAG | 1.69 | 1.68 | 1.67 | Decrease | Yes |
| SACOG | 1.69 | 1.68 | 1.67 | Decrease | Yes |
| DRCOG | 1.37 | N/A | 1.5 | Increase | Yes |

*Table 6* — *TTTR Index. Source: Various, See Appendix D*

Like the measures above, the TTTR Index is produced from the National Performance Management Research Data Set. This target addresses the reliability of travel time for trucks on the Interstate system. Larger numbers equate to more unreliable travel times. As shown in Table 6, MAG, NCTCOG and DRCOG all show

negative increasing trends in TTTR while SCAG and SACOG show slight decreases in their targets. While MAG has the second lowest baseline, our 4-year target is the third highest.

The next two measures below are specific to metropolitan areas and are not statewide in their reach. Thus, these targets do not align with any state DOT, although MPOs and DOTs often work in conjunction to calculate and set the targets for the region. Uniquely, SCAG is divided into two distinct large urban areas, and reports separate targets for the Los Angeles-Long Beach-Anaheim urban area and the Riverside-San Bernardino urban area.

| MPO | Urban Area | Peak Hour Excessive Delay Per Capita (Hours) Baseline | Peak Hour Excessive Delay Per Capita (Hours) 2-Year | Peak Hour Excessive Delay Per Capita (Hours) 4-Year | Trend |
|---|---|---|---|---|---|
| MAG | Phoenix-Mesa | 6.34 | 8.8 | 10.9 | Increase |
| NCTCOG | Dallas-Fort Worth-Arlington | 15.5 | N/A | 15 | Decrease |
| H-GAC | Houston | N/A | N/A | 16 | N/A |
| SCAG | Los Angeles-Long Beach-Anaheim | N/A | 51.2 | 51.1 | Decrease |
| SCAG | Riverside-San Bernardino | N/A | 16.1 | 16 | Decrease |
| SACOG | Sacramento | N/A | N/A | 14.7 | N/A |
| DRCOG | Denver-Aurora | N/A | 52 | 54 | Increase |

*Table 7* — *Peak Hour Excessive Delay Per Capita. Source: Various, See Appendix D*

As shown above in Table 7, the Peak Hour Excessive Delay target is measured by the annual hours of excessive delay per capita on the NHS. While Phoenix-Mesa and Denver-Aurora report worsening trends, Dallas-Fort Worth-Arlington, Los Angeles-Long Beach-Anaheim, and Riverside-San Bernardino all report improving trends in excessive delay. Neither Houston nor Sacramento made baseline data points available for comparison. While Phoenix-Mesa has the largest increase in Peak Hour Excessive Delay per Capita, from 6.34 to 10.9, Phoenix still has the lowest 4-year target of our peer urban areas.

| MPO | Urban Area | % Non-SOV Travel Baseline | % Non-SOV Travel 2-Year | % Non-SOV Travel 4-Year | Trend |
|---|---|---|---|---|---|
| MAG | Phoenix-Mesa | 23.40% | 22.90% | 22.60% | Decrease |

| | | | | | |
|---|---|---|---|---|---|
| NCTCOG | Dallas-Fort Worth-Arlington | 19.50% | 19.90% | 20.20% | **Increase** |
| H-GAC | Houston | 20.10% | 19.70% | 19.50% | **Decrease** |
| SCAG | Los Angeles-Long Beach-Anaheim | 25.60% | 26.10% | 26.60% | **Increase** |
| SCAG | Riverside-San Bernardino | 22.70% | 23.20% | 23.70% | **Increase** |
| SACOG | Sacramento | 22.80% | N/A | 23.80% | **Increase** |
| DRCOG | Denver-Aurora | 23.90% | 24.00% | 25.00% | **Increase** |

*Table 8* — *Non-SOV Travel. Source: Various, See Appendix D*

The Percent of Non-SOV travel target is drawn from the American Community Survey commuting data. This data aggregates the percentage of all trips taken by some other mode than single occupancy vehicle travel. This includes public transportation, carpooling, rideshares, and active transportation modes. Increasing percentages of non-SOV travel can help reduce congestion and increase reliability. Both MAG and H-GAC have negatively decreasing trends in non-SOV travel, while all other urban areas see increasing positive trends in percentage of non-SOV travel.

For all PM3 measures, MAG and the Phoenix-Mesa Urban Area are the only to report negative trends in all five target measures, representing worsening system reliability and longer travel times and delays. However, for these targets, SCAG, SACOG and DRCOG chose to support the statewide targets rather than calculate their own, which may not reflect actual conditions in their respective MPO regions.

## Regional Mobility & Congestion

Despite being the 11th largest metropolitan statistical area in the U.S.[2], Tom Tom Travel Index data lists Phoenix as the 42nd most congested city for 2020[3]. That puts the level of congestion in Phoenix below cities such as Providence, Albuquerque, and Tucson. Nevertheless, the MAG region still experiences congestion, particularly during peak periods. Congestion affects the movement of goods and people, and has environmental impacts due to increased fuel consumption. Annually, Texas A&M University Transportation Institute, a nationwide leader in assessing the impacts of congestion, estimates that congestion costs the region $3.3 billion[4].

As Chart 8 shows, Arizona's population has been steadily growing along with VMT. This trend is expected to continue and will place further stress on our transportation system. This will lead to increased congestion should mitigation efforts be unable to keep pace.
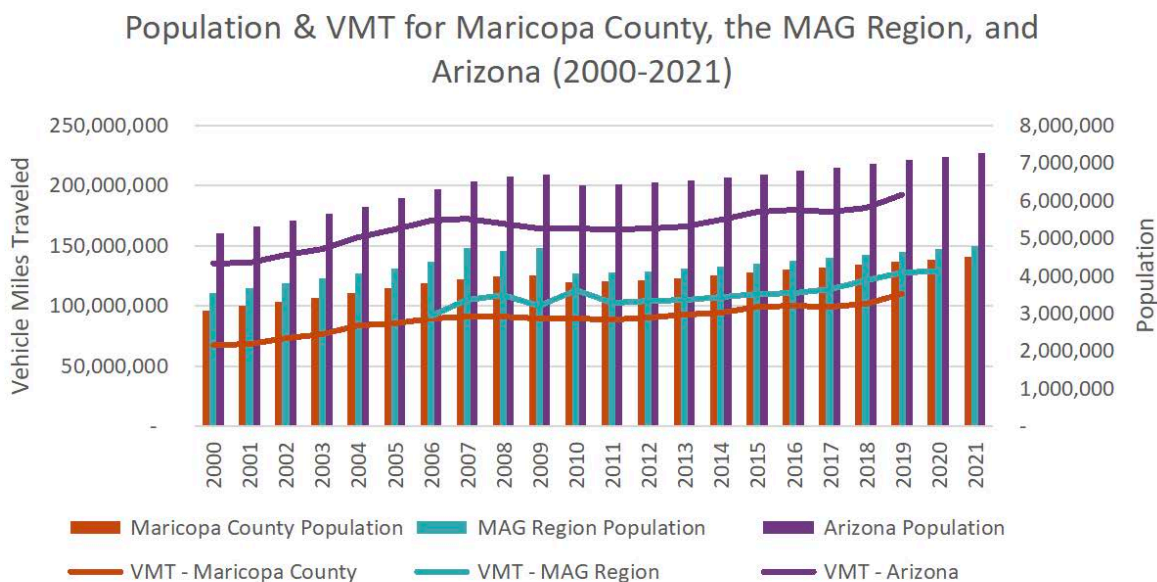


**Chart 8** - *VMT & Population, 2000-2019. Source: ADOT HPMS, MAG TDM*

MAG uses several data sources to examine congestion in the region across a variety of facilities. For the purposes of performance measurement, congestion is defined as a ratio of the measured speed divided by the speed limit for each stretch of roadway in the network. The data is further broken down by time periods.

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[2] https://www.census.gov/library/visualizations/interactive/2020-population-and-housing-state-data.html. Accessed 9/9/2021.

[3] https://www.tomtom.com/en_gb/traffic-index/ranking/?country=US. Accessed 3/23/2021.

[4] https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2019.pdf. Accessed 3/23/2021.

There are two types of congestion:

## Recurring

Daily congestion—not related to construction, crashes, or special events—is known as recurring congestion. TTI publishes an annual mobility report that attempts to quantify the costs of congestion. Per their 2019 report, congestion in the Phoenix area costs the average auto commuter approximately $1,169 a year between excess gas consumption and the loss of 62 hours of their time[5].

### *Freeway Bottlenecks*

Freeway congestion is distributed across the region and is primarily observed during the AM (6 AM – 9 AM) and PM (2 PM – 6 PM) peak periods. Congestion is also observed during the midday (9 AM – 2 PM) and nighttime (6 PM – 6 AM) periods, though less frequently. Freeway bottlenecks are a series of congested and consecutive freeway segments which repeatedly cause significant delay to travelers. Freeway bottlenecks are typically recurring and observed at similar locations in a particular direction, day in and day out. Some bottlenecks only occur during a specific peak period, and some occur during multiple peak periods. The comprehensive temporal-spatial coverage of speed data allows us to study and measure freeway bottlenecks on a daily level, throughout an extended period.

- *Freeway traffic has been greatly impacted by the COVID-19 pandemic, beginning in spring 2020.* Freeway traffic volumes and congestion significantly decreased at the onset. These reductions were largely due to the widespread transition to teleworking solutions and travel restrictions originally put in place. After bottoming out at 60 percent of normal traffic volumes in April 2020, freeway traffic began to gradually increase, reaching 90 percent of normal by the fall of 2020. The recovery pace of traffic congestion has been slower than that of traffic volume. By the end of 2020, freeway congestion in the region was at only 50 percent of pre-COVID conditions. Since March 2021, freeway traffic volume has returned to 100 percent of pre-COVID conditions, however the total freeway congestion in the region is at 60 percent of pre-COVID conditions.

- *Travel patterns have changed and continue to evolve.* Not only is the level of freeway congestion lower, but its characteristics also look different because travel patterns have changed. For example, a sizable portion of commute trips between home and work vanished in 2020 when the workforce largely shifted to full- or part-time telecommuting. This contributed greatly to the reduced traffic congestion during the peak periods. Starting with the second half of 2021, as portions of the workforce return to full- or part-time in-person work, it is expected that congestion characteristics will continue to evolve. At this point, it is not clear when or how the new travel patterns will stabilize.

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[5] https://mobility.tamu.edu/umr/congestion-data/

- *Peak period congestion looks different*. AM peak period traffic has flattened, mainly for the reasons mentioned above, while midday congestion levels have increased above the usual levels. At some freeway segments, the congestion during midday is worse than the congestion during the AM peak. Throughout the entire day, the PM peak remains to be the busiest peak period in both traffic volume and congestion on the freeway system.

- *Freeway bottleneck locations and characteristics have altered.* Since the spring of 2020, not only has the freeway system's congestion levels and patterns continued to evolve, but freeway bottleneck positions and attributes have also transformed. There are bottlenecks which have fully recovered to pre-COVID conditions since fall of 2020, and there are bottlenecks that still have not recovered to their pre-COVID conditions. Meanwhile, new bottlenecks have formed on the regional freeway system due to non-COVID reasons. For instance, I-10 westbound between 75th Avenue and 43rd Avenue is a new bottleneck mainly caused by the connection of Loop 202 (South Mountain Freeway) which opened to traffic in December of 2019. While this section was not congested in the first half of 2020, with the traffic continuing to recover and travelers' path choice patterns gradually getting settled in the second half of 2020, congestion has developed in this area.

Due to the reasons discussed above, characteristics of the region's freeway bottlenecks have been fluid, with their congestion delay, duration, and position rapidly evolving. As it is difficult to quantitively measure freeway bottlenecks which continuously evolved in 2020 and 2021, only speed data in March and April of 2021 were selected to analyze and measure freeway bottlenecks for this report. During this time frame, freeway traffic volume is at 100 percent of pre-COVID conditions and freeway congestion is still significantly lower than pre-COVID conditions. The current the top five congested freeway bottlenecks are shown in Figure 1 below.
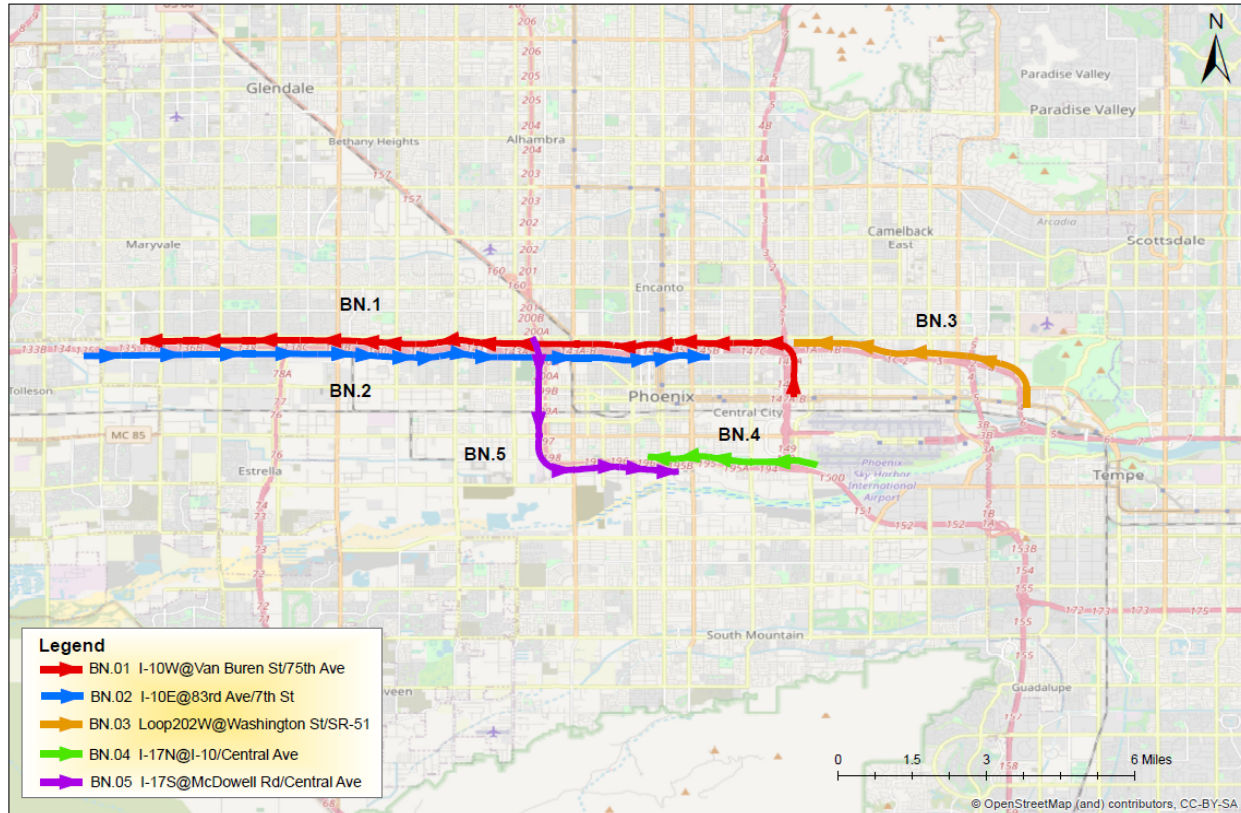
*Figure 1* - *Top Five Congested Freeway Bottlenecks (2021). Source: INRIX*

**#1** -– Westbound I-10, from approximately Van Buren Street to 75th Avenue.

**#2** – Eastbound I-10, from approximately 83rd Avenue to 7th Street.

**#3** – Westbound Loop 202 (Red Mountain Freeway), from approximately Washington Street to SR 51.

**#4** -– Northbound I-17, from approximately from I-10 to Central Avenue.

**#5** – Southbound I-17, from approximately McDowell Road to Central Avenue.

These bottlenecks present different congestion delay characteristics, as shown in the following charts. The chart on the left indicates the bottleneck's length (color of ring, green as short and purple as long), duration (length of ring), and occurrence time (from inner ring to outer ring as from March 1, 2021 to April 30, 2021). The chart on the right displays the bottleneck's speed profile of average speed, 5% speed, 25% speed, 75% speed, and 95% speed.

## Bottleneck #1 - Westbound I-10, from approximately Van Buren Street to 75th Avenue

The traffic congestion is mainly observed between 2 PM and 7 PM during weekdays. The average speed during the peak hour at this bottleneck is 30mph. This bottleneck was top-ranked last year pre-COVID, with a lower congested speed of 20-25mph.
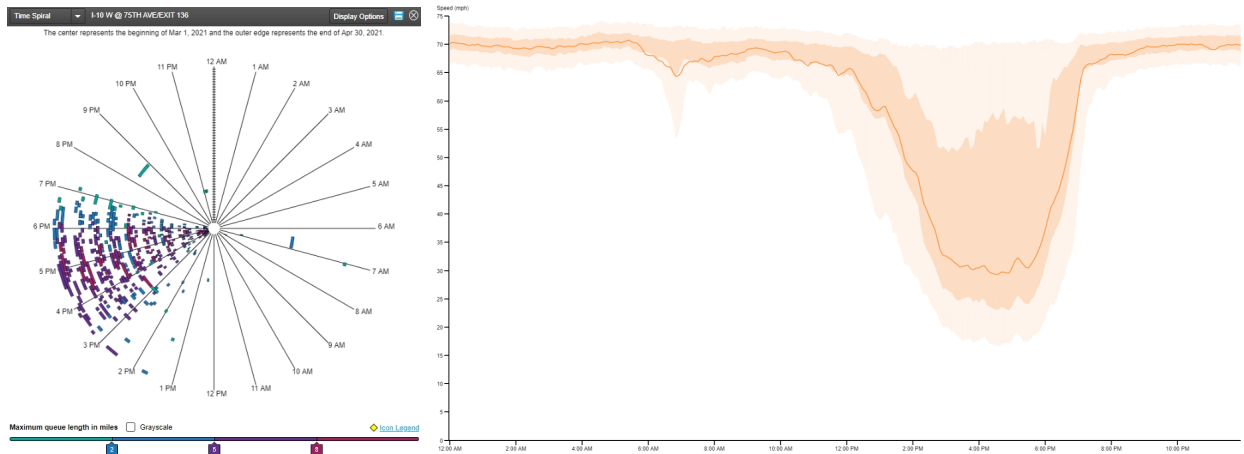


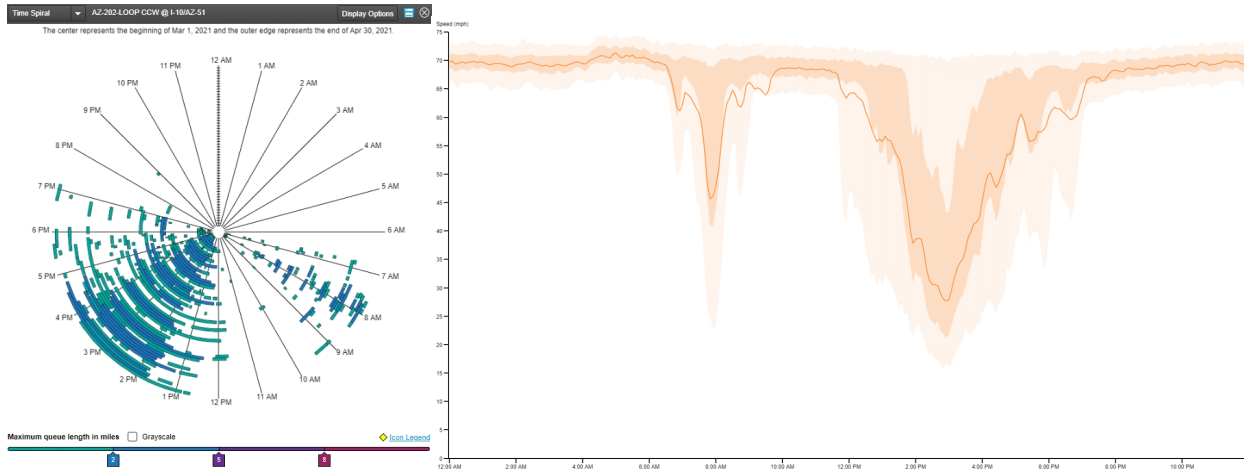## Bottleneck #2 - Eastbound I-10, from approximately 83rd Avenue to 7th Street

This bottleneck is observed in both AM and PM during weekdays. The average speed of AM at 35mph is lower than average speed of PM at 45mph, while the duration of congestion during PM is longer.
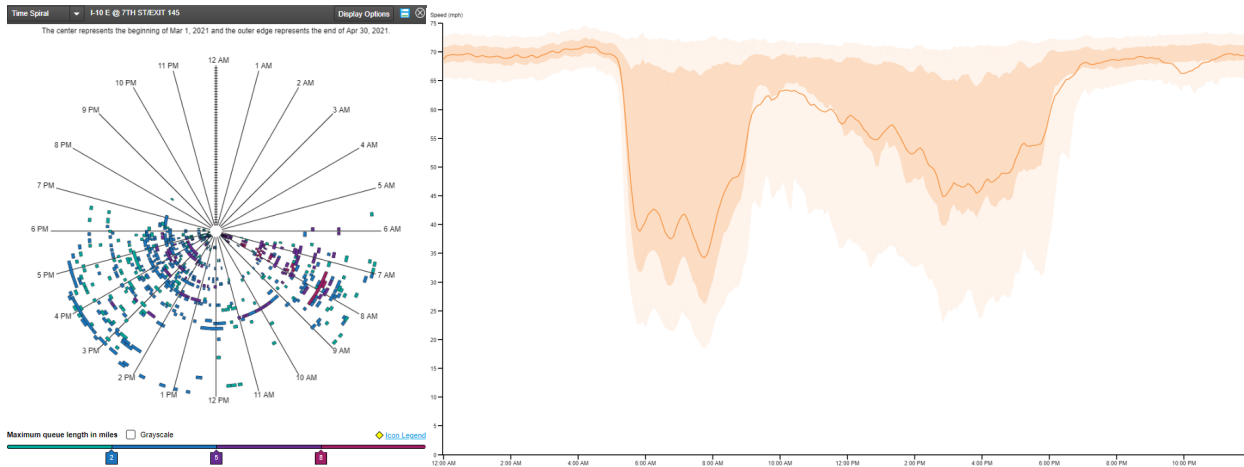


## Bottleneck #3 - Westbound Loop 202 Red Mountain, from approximately Washington Street to SR-51

The congestion on this bottleneck mainly occurs during both AM and PM on weekdays. The duration of congestion during AM is shorter than pre-COVID conditions. The congested speed during PM drops as low as 30mph which is slightly higher than pre-COVID conditions.

## Bottleneck #4 - Northbound I-17, from approximately from I-10 to Central Avenue

This bottleneck is mainly observed from noon to 7 p.m. during weekdays. The average speed during the peak hour is 20mph. This bottleneck was ranked outside of the top 10 during pre-COVID conditions.
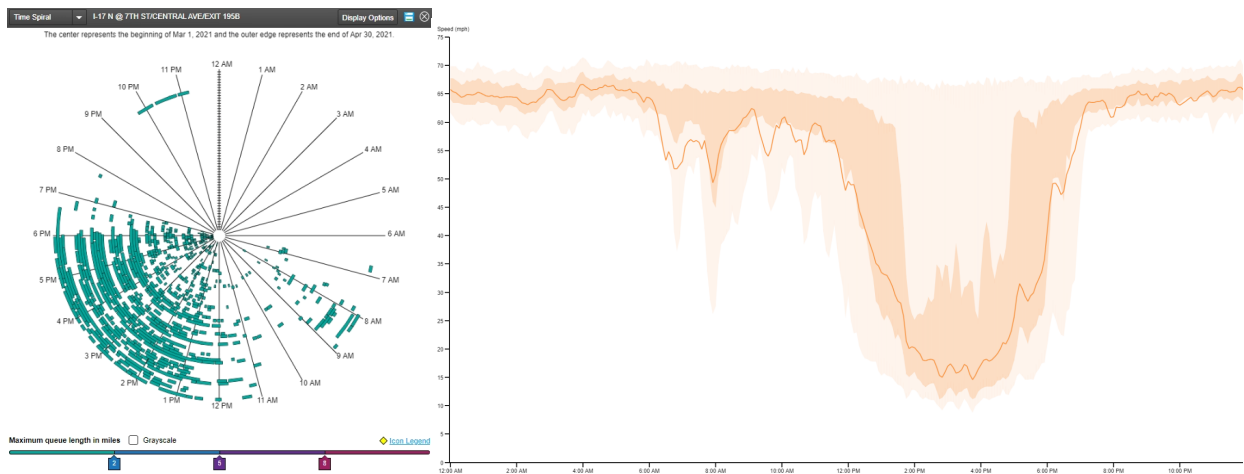
## Bottleneck #5 - Southbound I-17, from approximately McDowell Road to Central Avenue

This bottleneck occurs during both AM and PM in weekdays, and the congested speed is observed to be 45mph. This bottleneck was ranked outside of the top 10 during pre-COVID conditions.
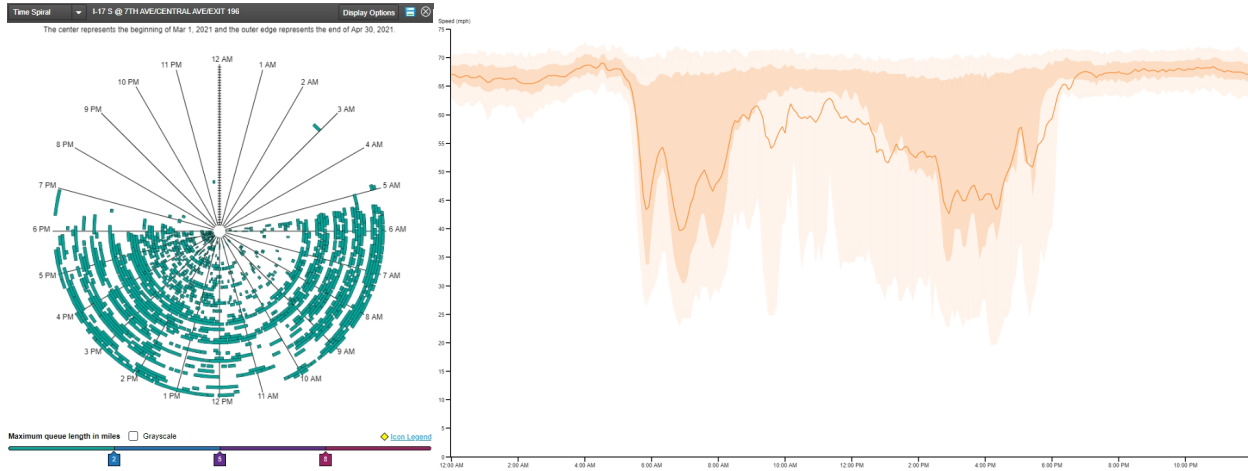


## Non-recurring

Congestion caused by construction, crashes or special events is classified as non-recurring. This type of congestion is more difficult to mitigate due to its sporadic nature. Identifying and being prepared to respond quickly to non-recurring congestion events is vital to reducing their impact. The 2020 System Performance Report contains an example of non-recurring congestion at State Farm Field, but hundreds of events occur in our region each year. Each one brings unique challenges and stresses to our network.

| Performance Indicator | Fixed-Route Bus | Light Rail | Paratransit | Vanpool | System Total | % Change from FY18 |
|---|---|---|---|---|---|---|
| Total Boardings | 49,296,022 | 15,084,312 | 1,134,014 | 1,004,018 | 66,518,366 | -3.5% |
| Percent of Total Boardings | 74.1% | 22.7% | 1.7% | 1.5% | --- | --- |
| Vehicle Revenue Miles | 35,485,860 | 3,351,956 | 10,261,552 | 5,822,883 | 54,922,251 | -0.19% |
| Operating Cost Per Revenue Mile | $8.06 | $14.55 | $5.28 | $0.56 | $7.14 | 7.0% |
| Boardings Per Revenue Mile | 1.39 | 4.5 | 0.11 | 0.17 | 1.21 | -2.4% |
| Average Fare | $0.74 | $0.73 | $2.72 | $3.36 | $0.81 | -2.4% |
| Farebox Recovery | 12.8% | 22.7% | 5.7% | 103.5% | 13.8% | -1.7% |
| Operating Cost Per Boarding | $5.80 | $3.23 | $47.78 | $3.25 | $5.90 | 10.1% |
| Subsidy Per Boarding | $5.80 | $2.50 | $45.05 | ($0.11) | $5.08 | 12.1% |

## Transit System Performance

Valley Metro annually publishes a report on the performance of their transit system. It includes fixed-route bus, light rail, paratransit, and vanpool. Annual reports beginning from 2007 can be found here: https://www.valleymetro.org/transit-performance-reports.

Previously, MAG has not developed regional transit targets. While TAM and PTASP cover important performance measures related to safety, security, administration, and finance, transit performance measures that analyze service availability, service delivery, and community impact are not covered. To offer a broader depiction and analysis of the entire transportation system in the MAG region, transit performance measures are now being developed to reflect various transportation modes.

### Current Transit Performance Measures

Two transit-specific performance measures are mandated by the federal government: TAM and PTASP. MPOs can elect to support the targets of transit service providers or develop regional targets, but MAG has not yet developed regional transit targets.

Since 2018, transit providers that receive Chapter 53 federal funds are mandated to create a TAM plan[6]. The TAM plan assists agencies in managing their assets, both operationally and financially. TAM performance measures report on the state of good repair of assets such as rolling stock, equipment, facilities, and infrastructure.

PTASP are required from certain operators to develop safety performance targets. The first iteration of PTASP were due to the FTA on December 31, 2020. The plans must be updated and certified by the providers annually thereafter. Valley Metro and the City of Phoenix are currently developing their PTASPs. Like the TAM plans, the PTASP will be taken through MAG's committee process for approval.

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[6] https://www.transit.dot.gov/TAM/TAMPlans Accessed 2/8/2021

*Table 9* - *System Performance for FY19. Source: Valley Metro*

Alongside these federal requirements, Valley Metro releases the annual Transit Performance Report referenced above. As seen in Table 9, the performance indicators used primarily represent the financial performance of Valley Metro. The indicators are further broken down into their respective modes: bus, light rail, paratransit, and vanpool along with the overall system total. The report further illustrates temporal trends in these indicators.

The comparison of peer agencies' financial, operation, and asset conditions is simplified through the National Transit Database that uniformly reports on the financial performance of public transit agencies nationwide.

While performance measures are well-documented for safety, security, agency administration, and financial performance, there have yet to be transit performance measures adopted that measure system availability, service delivery, or community impact. This is not to say that the performance of Valley Metro in these areas has not been analyzed or reported, but rather that there are no uniform standards nor targets at the MPO level.

In fact, peer agencies and MPOs often divide the reporting of performance measures in ways that align with each agency's goals. Transit agency measures tend to focus on financial performance and customer service, where MPOs are more concerned about the location, quality, and equitability of transit service.

### Service Availability

Transit is only a feasible option if it is easily available to passengers, making service availability one of the most important metrics of transit. Service availability measures where, how often, and how long service is provided. These three measurements form the basis of transit performance:

- Service Coverage
- Frequency
- Hours of Service

### Service Coverage

One of the most visible aspects of service availability is the area that the system covers and how many people can access the system. As of spring 2020, the Valley Metro service areas spanned 527 square miles within Maricopa County. While service coverage can be visualized through the total service area of the transit system, riders can only access services at designated points and areas like bus stops and transit centers. Using data from the 2018 American Community Survey, the Spring 2020 Valley Metro System Fact Sheet reports that of the 4.2 million residents in the county, 2.1 million are within ¼ mile walking distance of a bus stop, accounting for 51 percent of the total county population.

Being able to access the service is only a part of service availability. Figure 2 below shows the frequency of service within a ¼ mile walking mile distance of bus stops in the system. While the system has extensive coverage of the metropolitan area, the number of trips per hour varies drastically. The map below shows a snapshot of

service coverage and frequency during weekday morning peak commute hours (6 AM – 9 AM.)
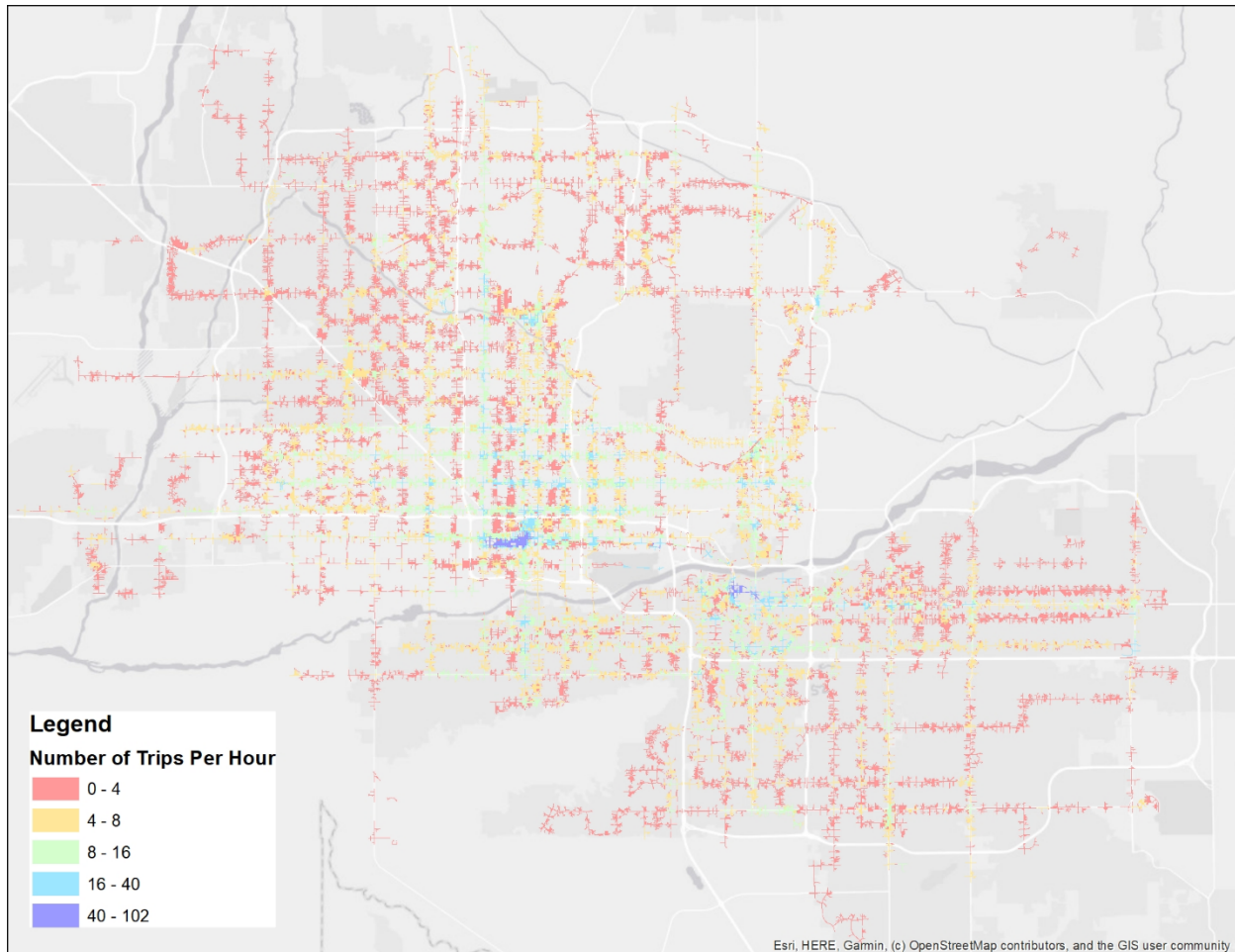


*Figure 2 - Number of Trips per Hour, Weekday AM*

In Figure 2, the dense urban cores of Phoenix and Tempe are clearly visible. With numerous routes and transit services, there are many different trips a rider could take within a ¼ mile walking distance. Expanding outside of these urban cores, transit service becomes sparser as residential and commercial densities lower. Given the mile grid system of arterial streets, many areas are not within the ¼ mile walking distance of these stops. While this does not physically inhibit riders from accessing transit, ridership decreases as distance from transit stop increases.[7]

Transit service can also be visualized through linking the number of stops to route length. Chart 9 shows the distribution of routes based on number of stops and route length.

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[7] Chapter 4, Page 18, Transit Capacity and Quality of Service Manual, 3rd Edition
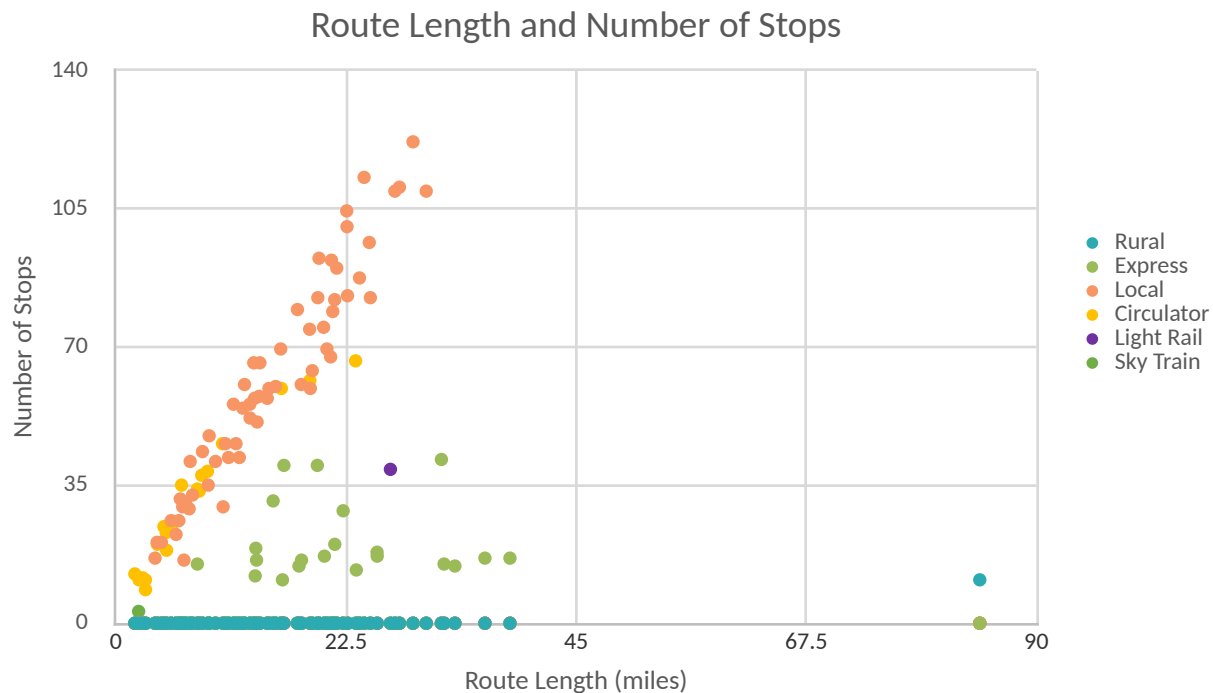
## Route Length and Number of Stops



**Chart 9** - *Route Length and Number of Stops*

As expected, longer routes have more stops, but the presence of long routes with fewer stops highlight express and commuter bus service with frequent stops at the beginning and end of the line with limited stop service along freeways. The outlier in the bottom right corner shows the singular long-range rural route in operation.

This route distribution is common among transit agencies nationwide. The transit routes of Southeastern Pennsylvania Transportation Authority (SEPTA), which provides service for Greater Philadelphia, are distributed in Chart 10 below. This chart similarly distinguishes between routes with dense stop placement and commuter routes with limited stops.
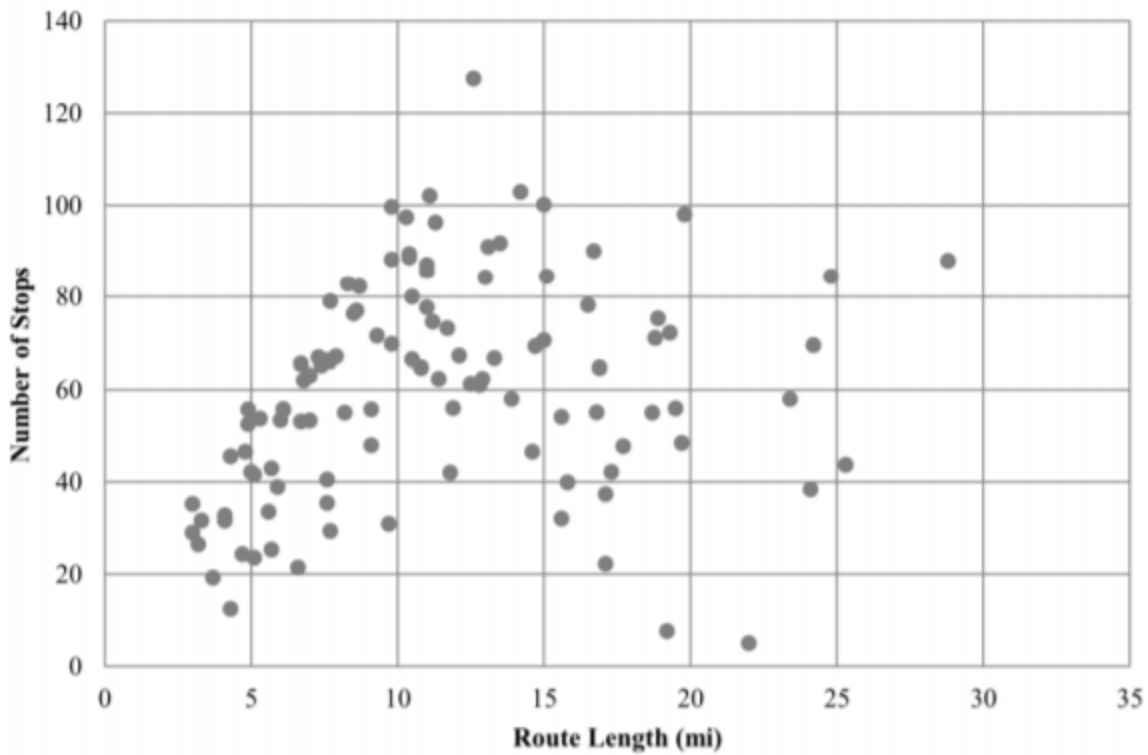
**Chart 10** - *Length and number of stops for SEPTA bus routes. Source: Georgia Institute of Technology*

The average length between stops can also characterize the types of services offered in the region. In Chart 11 below, the average distance between stops on each route is calculated.
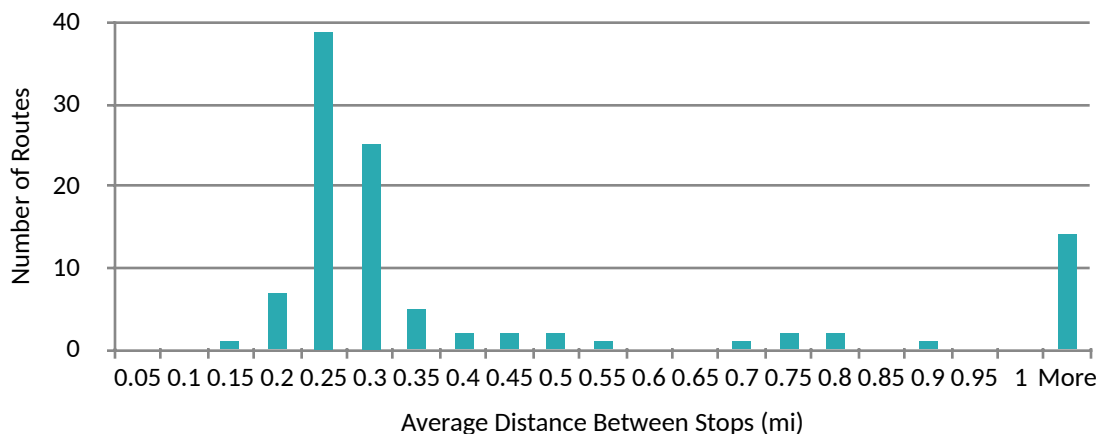
## Route-level Distance Between Stops



**Chart 11** - *Route-level Distance between Stops. Source: Valley Metro GTFS*

Chart 11 shows the average distance between stops on each route. The most common average distance between stops falls within ¼ miles. There are also a

sizeable number of routes with more than a one-mile average distance between stops, indicating express and limited stop services. This makes sense given the MAG region's one-mile arterial grid structure. Shorter average distances imply routes in dense urban areas that can support more frequent stops, while longer average distances are due to service in lower density neighborhoods and commuter, express and rural service with limited stops.

*Frequency*

Alongside coverage, frequency is a particularly meaningful performance measure, as the frequency of service impacts ridership and likeliness of transit usage. Higher frequency means riders put less effort into trip planning and can rather walk to the stop and know the next bus or train will arrive in a reasonable time.

The Transit Capacity and Quality of Service Manual (TCQSM), published by the Transportation Research Board, separates service frequency into distinct categories of service levels and outlines how the passenger and operators perceive these types of service levels. An important concept in service levels is the time between transit vehicles on a route. This is known as the headway. As average headways increase, passengers must spend more time planning their trip to minimize wait times and can face non-optimal arrival and departure times. Operators benefit from lower operating costs and less bus bunching on less frequent routes. The table below summarizes the service standards detailed in the TCQSM.

| Average Headway | Passenger Perspective | Operator Perspective |
|---|---|---|
| >10 Minutes | •No need to plan ahead<br>•Bunching can affect vehicle passenger load | •Bus bunching more likely<br>•Feasible for very high-density corridors |
| 11-15 Minutes | •Check schedule to minimize wait time<br>•Maximum desirable wait time if bus or train is missed | •Suitable for higher density corridors |
| 16-30 Minutes | •Adapt travel to transit schedule<br>•Check to minimize wait time | •Usually 20 or 30 minute headways<br>•Moderate density corridors |
| 31-60 Minutes | •Adapt travel to transit schedule<br>•Non-optimal arrival/departure times | •Usually 45 or 60 minute headways<br>•Low-moderate density corridors |
| >60 Minutes | •Minimal service<br>•Undesirable for urban transit service | •Service Coverage Standard |

*Table 10 - Service Frequency & Perspectives. Source: TCQSM*
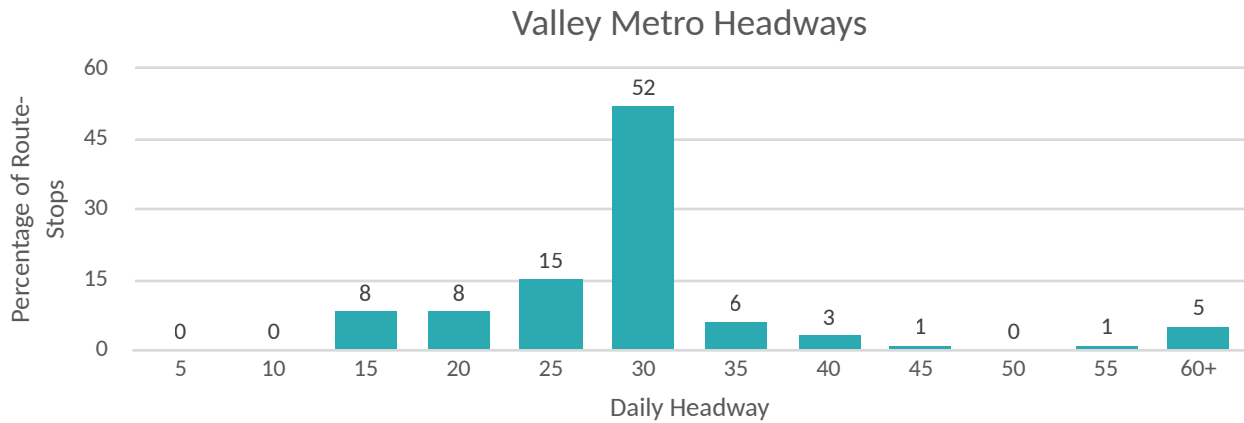
## Valley Metro Headways



**Chart 12** - *Average Weekday Route Headway Distribution*

Using General Transit Feed Specification data to analyze Valley Metro schedule data, Chart 12 depicts the average headways between every set of bus stops with service. The most common frequency is the 30-minute headway. Averaging all routes, Valley Metro riders can expect headways of 29.5 minutes.
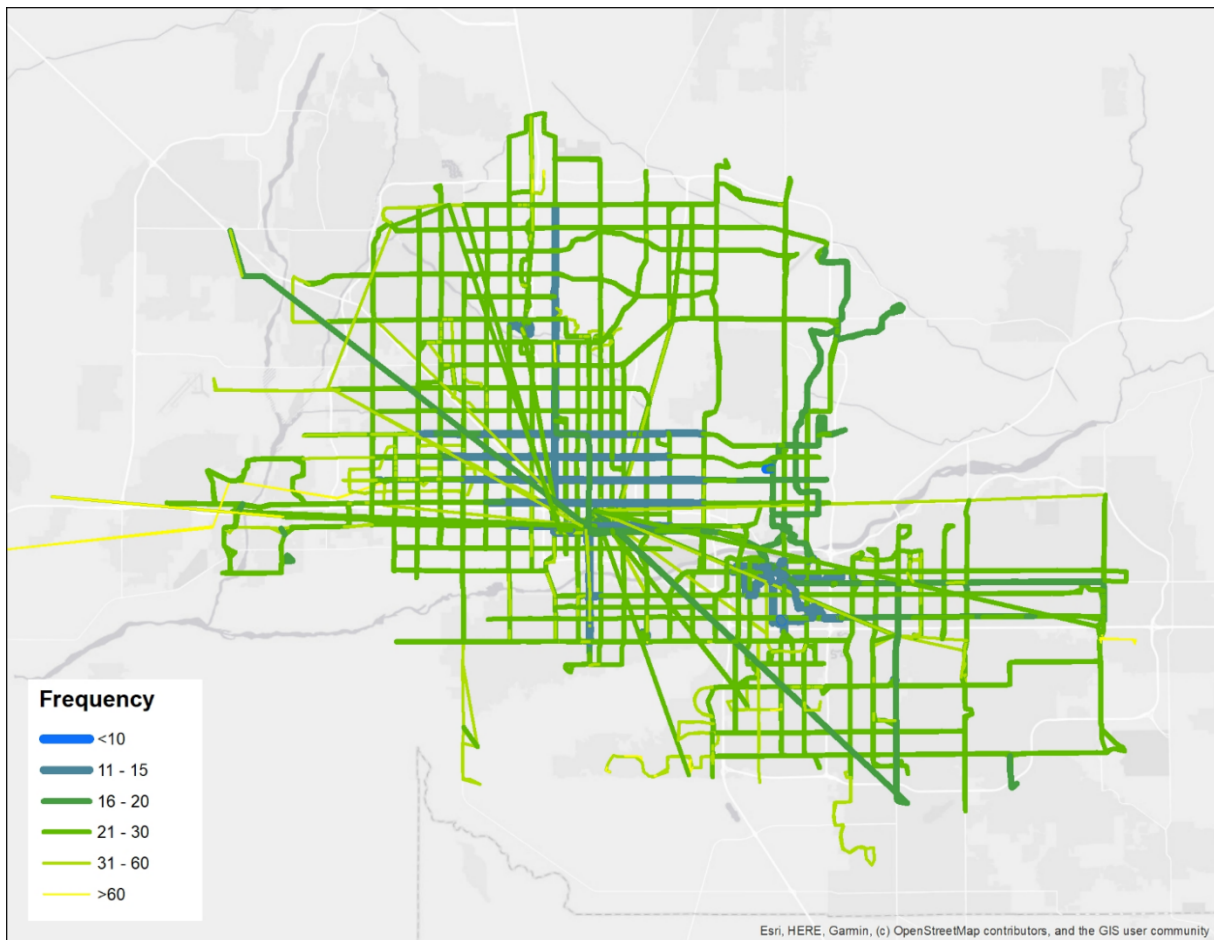


**Figure 3** – *Average Weekday Frequency on Valley Metro Routes*

Frequency can also be visualized through the frequency of transit service via two adjacent transit stops. Figure 3 above shows the frequency of routes between all stops on the map that have service. The paths of these lines do not reflect the actual path of the transit route or distance travelled.

As shown above, only a few routes reach frequencies lower than 15 minutes. These include bus routes on McDowell Road, Thomas Road, Indian School Road, Camelback Road, 19th Avenue, Central Avenue, as well as neighborhood circulators in Tempe. These corridors have higher density which justifies the level of service provided by the operator. While passengers will still check schedules, more frequent service means that a missed train or bus will not drastically alter the passenger's own timing and schedule. Outside of these areas, most routes fall within the 16-30 minutes frequency range. While this frequency is appropriate for moderate density corridors, passengers must adapt their schedule to the transit schedule and face suboptimal wait and transfer times.

*Hours of Service*

How long transit services operate throughout the day is also a crucial measure in evaluating the performance of public transit. Service coverage and frequency become irrelevant from the passenger perspective if a route is not provided at the time of day a potential passenger needs to travel. Longer service hours allow workers more flexibility to stay late at work or run errands before returning home. Like frequency, the TCQSM separates hours of service into distinct categories.

| Hours of Service | Passenger Perspective | Operator Perspective |
|---|---|---|
| >18 Hours | •Full range of trip purposes served<br>•Can avoid riskier travel late at night | •"Night" or "Owl" service<br>•May require late night pay for drivers and increased transit security |
| 15-18 Hours | •Broad range of trip purposes served | •May require route optimization or rerouting at night |
| 14. Hours | •Work trips based around traditional office hours<br>•Some arrival and departure time flexibility | •Can be covered by two full-time drivers per vehicle |
| 7-11 Hours | •Trips can be made in the middle of the day<br>•Not suitable for traditional office hours | •Can be covered by one or two drivers<br>•Not uncommon for smaller cities and rural towns |
| 4-6 Hours | •Often used for peak period commuter trips<br>•Some choice of AM and PM departures | •Sufficient for part-time drivers<br>•Minimum span for hourly service |
| <4 Hours | •Plan travel around schedule<br>•No flexibility | •Rural routes with few daily departures |

*Table 11 - Hours of Service & Perspectives. Source: TCQSM*

As the span of service hours increases, passengers can make more and more trips with various purposes like commuting to work, attending school, and running errands. With greater hours of service, operators must increase their staffing and vehicle usage, however operating costs usually increase by the same rate as that of the additional service added. For example, if an operator increases a route with 20 percent broader service span, the operating cost of the route will increase 20 percent as well. Similarly, adding 10 hours of service on a Saturday is equivalently as costly as adding 2 hours of service on five weekdays.[8]

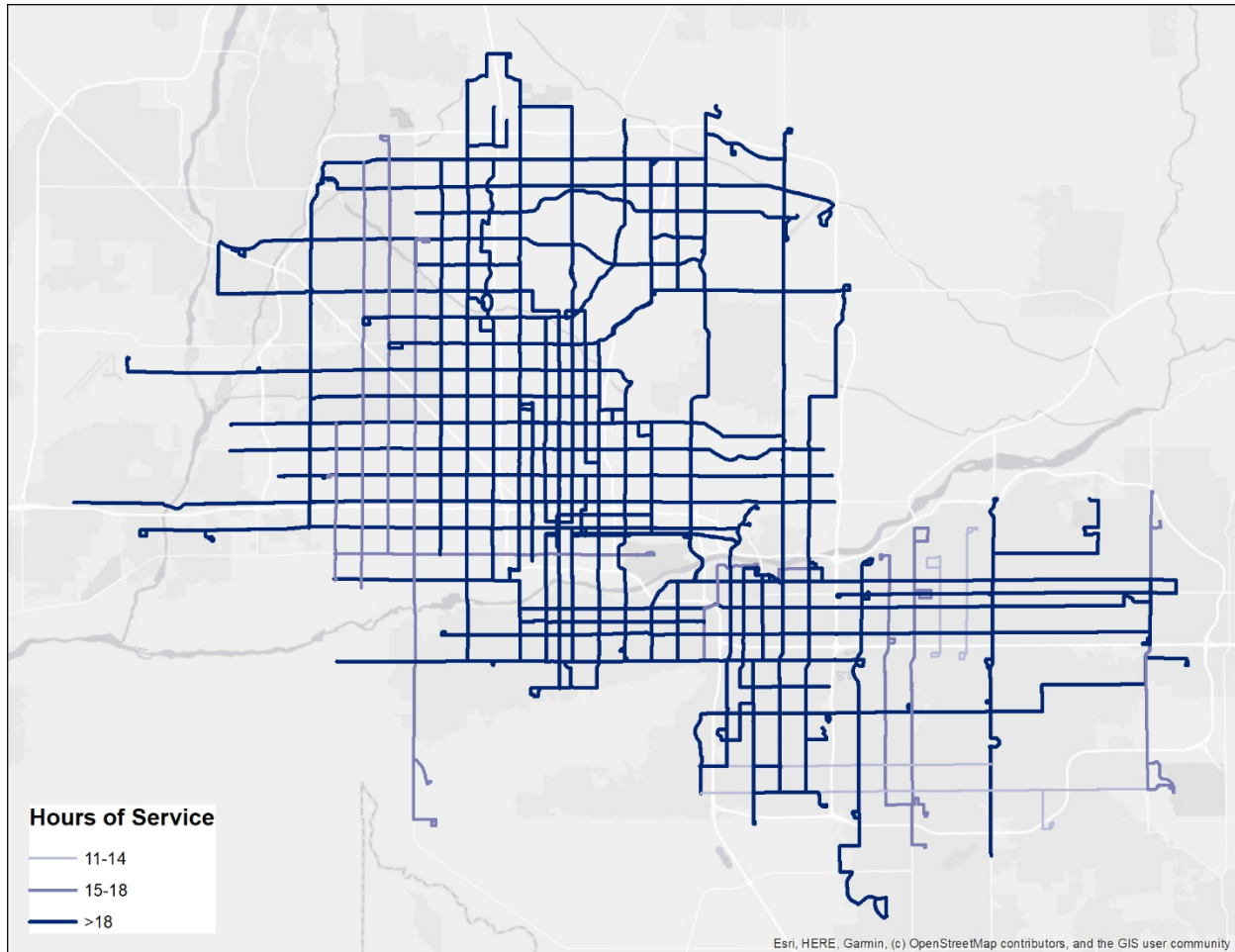In the figure below, the hours of service of Valley Metro routes are shown.



**Figure 4** - *Hours of Service of Valley Metro Local Bus Routes*

Most routes provide service at least 18 hours a day, the highest level according to TCQSM standards. These routes allow passengers to make a broad range of trips, at both early morning and late evening time periods. Routes with fewer hours of service in the 15 to 18 hours range and 11 to 14 hours range are found farther away from urban centers. While the map shows the highest hours of service for

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[8] Chapter 4, Page 18, Transit Capacity and Quality of Service Manual, 3rd Edition

each route, the hours of service may not be identical across the board. At earlier and later hours, routes are often truncated to focus on higher ridership areas that can reliably fill vehicles outside of peak hours.

## Future Transit Performance Measures

As transit performance measures continue to develop, the avenues to analyze and measure transit performance in our region will expand. As our region grows, service availability metrics will be an important part of ensuring our region is meeting the transportation needs of all residents.
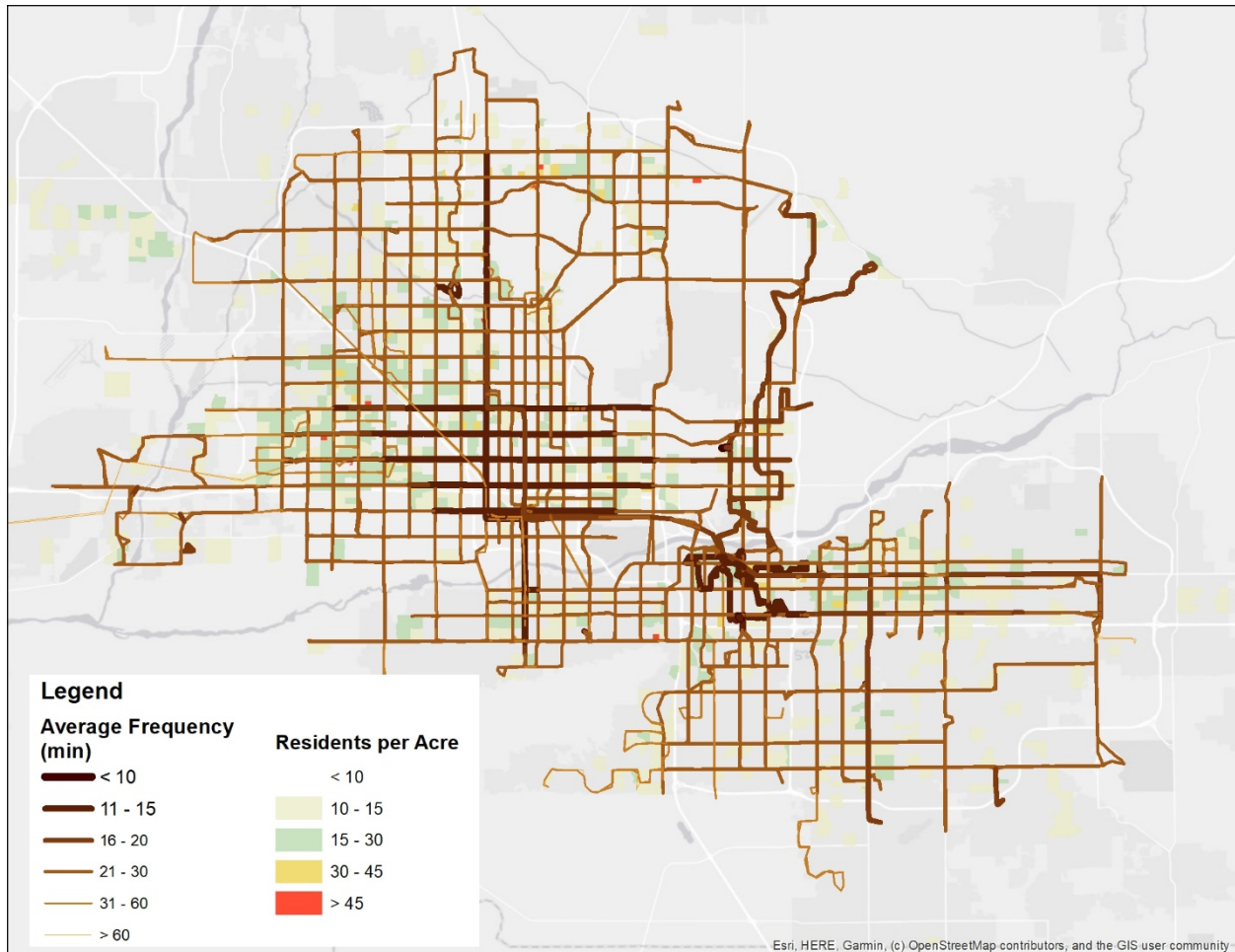


*Figure 5* - *Average Route Frequency and Residential Density by Census Tract. Source: American Community Survey*

In Figure 5, the map overlays transit route frequency with levels of residential density. As outlined in MAG's Regional Transit Framework Study Update, varying levels of density are suitable for different transit modes. Some areas with higher densities can support greater transit service investments, while other less dense areas have more service than their current density would suggest is necessary.

Beyond service availability, measures that evaluate residential and employment density alongside frequency can further measure our region's continued efforts to

build and maintain a multimodal transportation system that focuses on performance-based analysis.

## Corridor-Level Performance

To provide succinct information about traveling across the region, a collection of corridors representing major commuting routes have historically been used as illustrative examples. In the sections below, performance of each corridor is represented with a chart reflecting the travel time by year. As summarized in Table 12 and shown in Table 13, travel times in nearly all corridors have been increasing steadily.

| # | Commute Corridor | Change in Travel Time 2011-2019 (minutes) |
|---|---|---|
| 1 | I-10 to Loop 202 (Red Mountain): Eastbound - AM<br>I-10 at 83rd Ave to Loop 202 (Red Mountain) at Loop 101 | 06:10 |
| 1 | I-10 to Loop 202 (Red Mountain): Eastbound - PM<br>I-10 at 83rd Ave to Loop 202 (Red Mountain) at Loop 101 | 01:33 |
| 2 | SR 143 to I-10 to US 60: Eastbound - PM<br>SR 143 at Sky Harbor Blvd to US 60 at Val Vista Dr | 02:15 |
| 3 | I-10 to US 60: Eastbound - PM<br>I-10 at 7th St to US 60 at Loop 101 | 02:26 |
| 4 | Loop 101 (Price) to US 60 to I-10 to I-17: Westbound/Northbound - AM<br>Loop 101 (Price) at Guadalupe Rd to I-17 at Dunlap Ave | 01:18 |
| 4 | Loop 101 (Price) to US 60 to I-10 to I-17: Westbound/Northbound - PM<br>Loop 101 (Price) at Guadalupe Rd to I-17 at Dunlap Ave | 05:39 |
| 5 | I-17 to I-10: Eastbound - PM<br>I-17 at 19th Ave to I-10 at Elliot Rd | 03:09 |
| 6 | SR 143 to I-10: Southbound - PM<br>SR 143 at University Blvd to I-10 at Warner Rd | 02:10 |
| 7 | I-10 to SR 51: Eastbound/Northbound - PM<br>I-10 at 83rd Ave to SR 51 at Bell Rd | 01:00 |
| 8 | Loop 101: Northbound - AM<br>Loop 101 (Price) at US 60 to Loop 101 (Pima) at Frank Lloyd Wright Blvd | -00:37 |
| 8 | Loop 101: Northbound - PM<br>Loop 101 (Price) at US 60 to Loop 101 (Pima) at Frank Lloyd Wright Blvd | -00:35 |

*Table 12* - *Change in Travel Time along Selected Commute Corridors 2011-2019. Source: HERE*

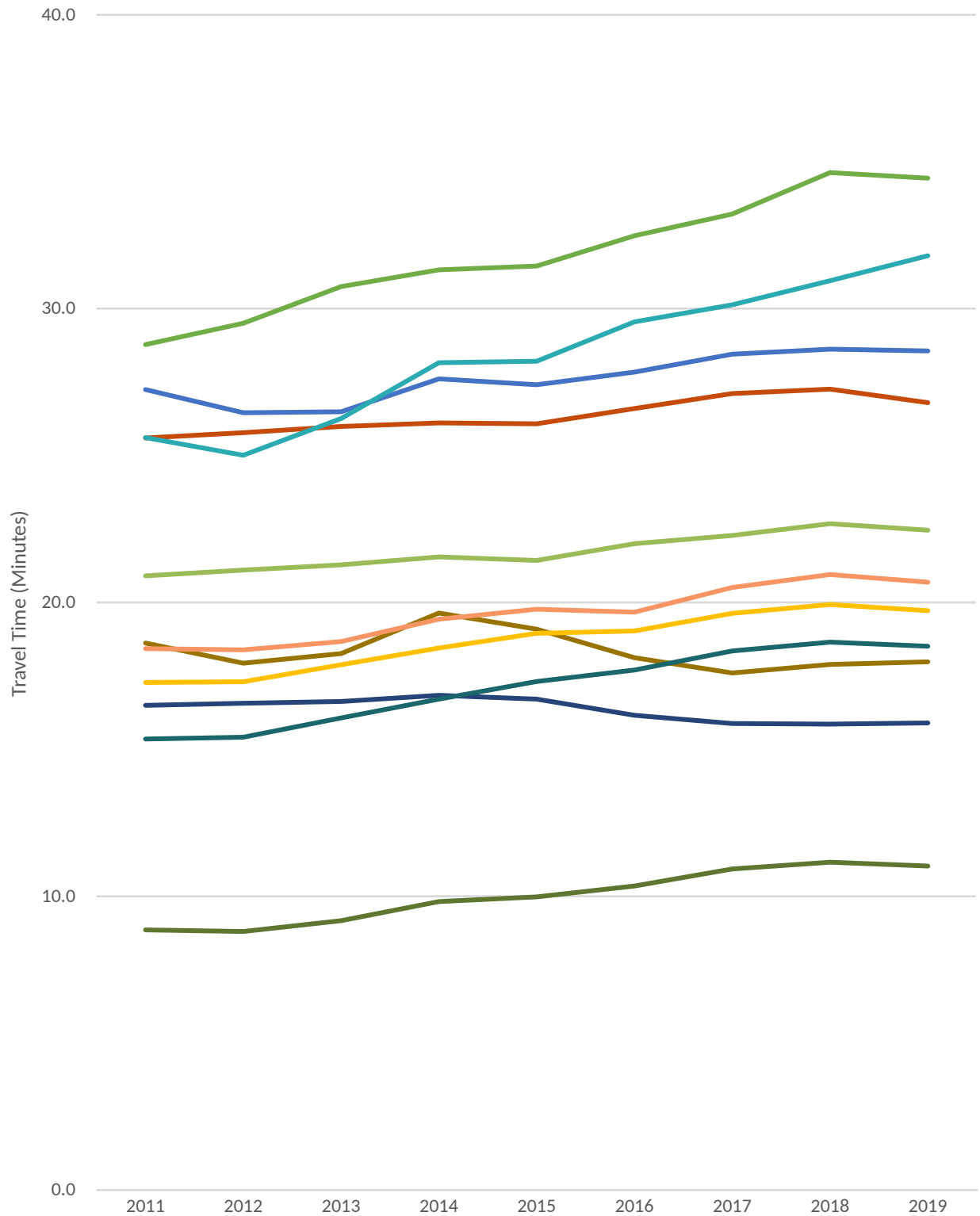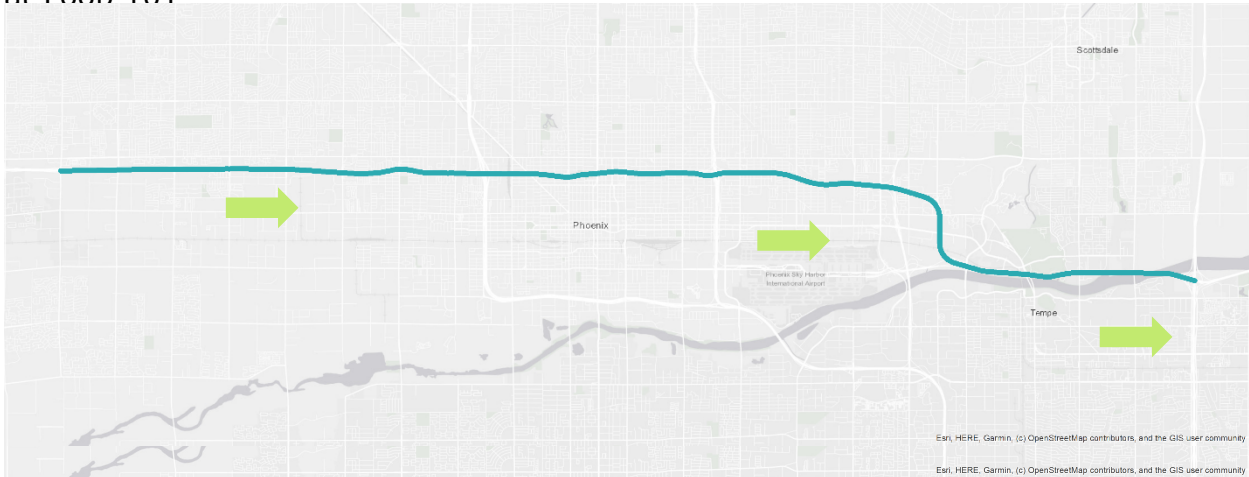## Travel Times Along Selected Commute Corridors



***Table 13** - Travel Times Along Selected Commute Corridors, 2011-2019. Source: HERE*
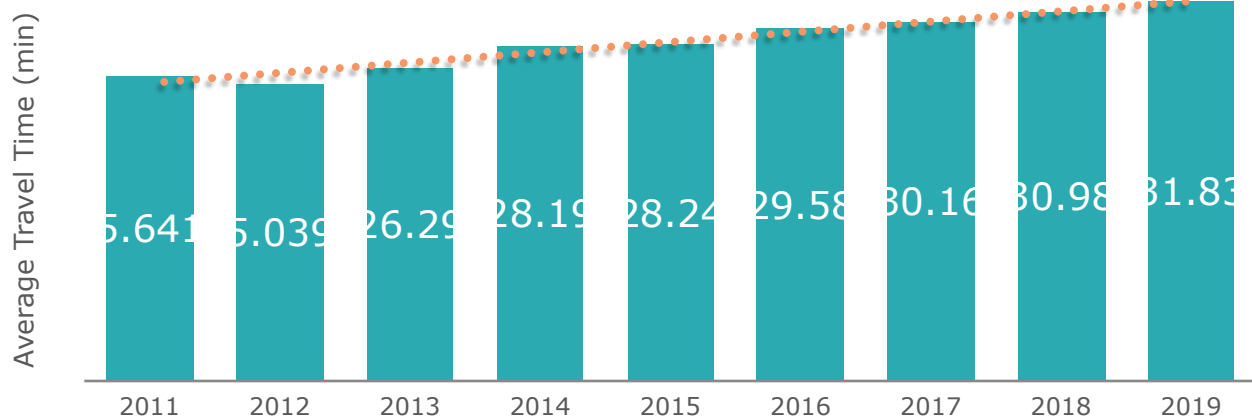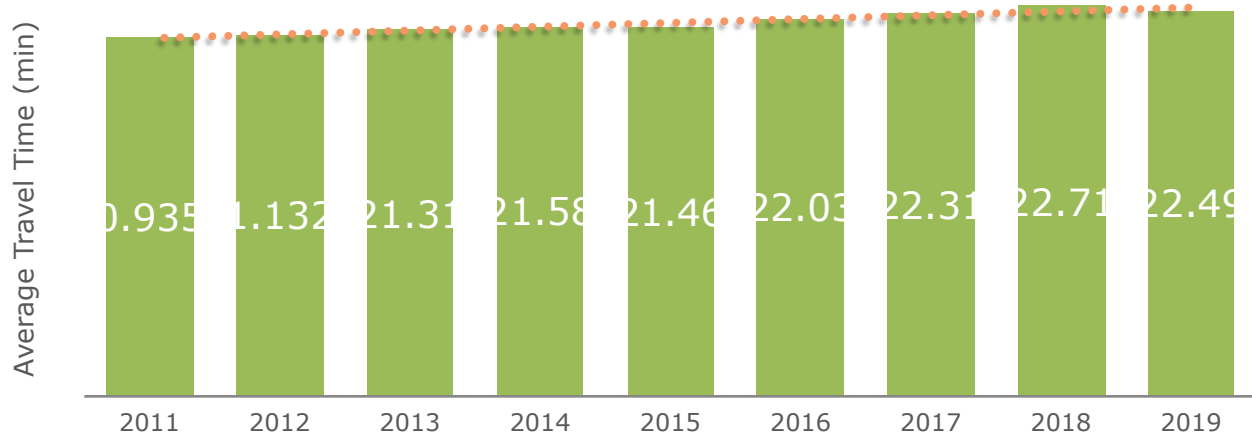
*Corridor 1*

**I-10 to Loop 202 (Red Mountain): I-10 at 83rd Avenue to Loop 202 (Red Mountain) at Loop 101**



### I-10 to Loop 202 (Red Mountain): Eastbound - AM
### I-10 at 83rd Ave to Loop 202 (Red Mountain) at Loop 101 (Price)



| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|------|
| Average Travel Time (min) | 5.641 | 5.039 | 26.29 | 28.19 | 28.24 | 29.58 | 30.16 | 30.98 | 31.83 |

### I-10 to Loop 202 (Red Mountain): Eastbound - PM
### I-10 at 83rd Ave to Loop 202 (Red Mountain) at Loop 101 (Price)



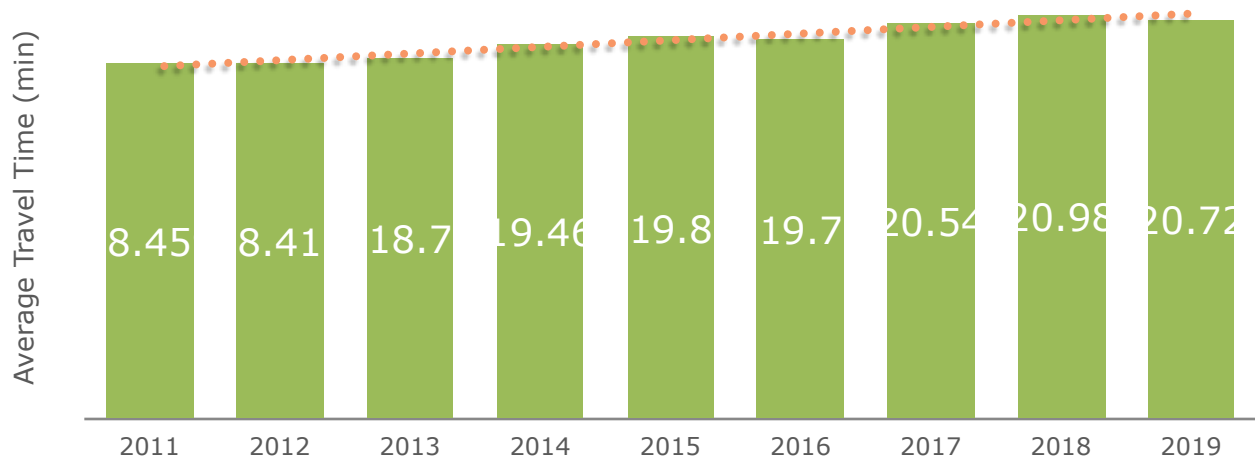| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|------|
| Average Travel Time (min) | 0.935 | 1.132 | 21.31 | 21.58 | 21.46 | 22.03 | 22.31 | 22.71 | 22.49 |

*Corridor 2*

## SR 143 to US 60: SR 143 at Sky Harbor Boulevard to US 60 at Val Vista Drive
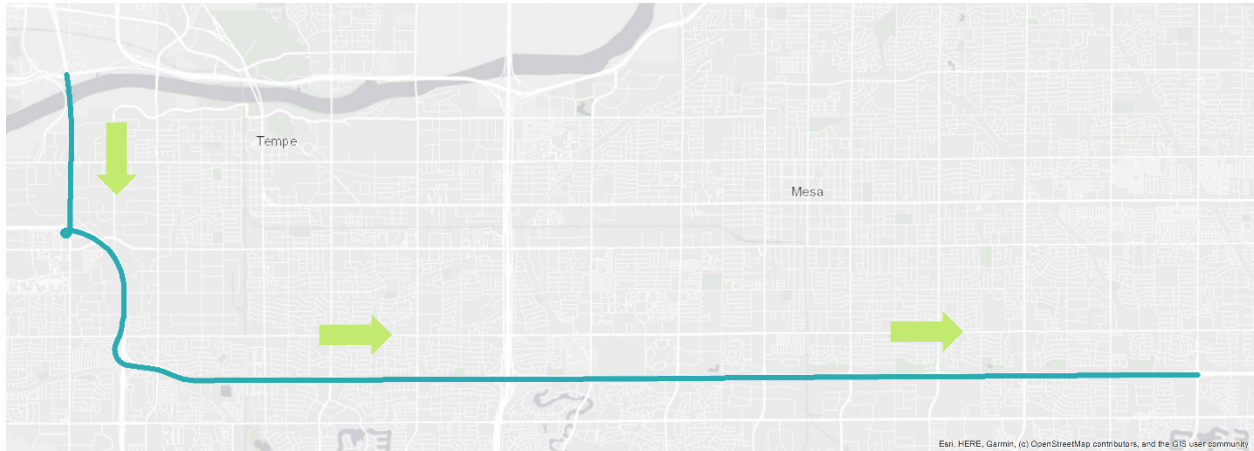


### SR 143 to I-10 to US 60: Eastbound - PM
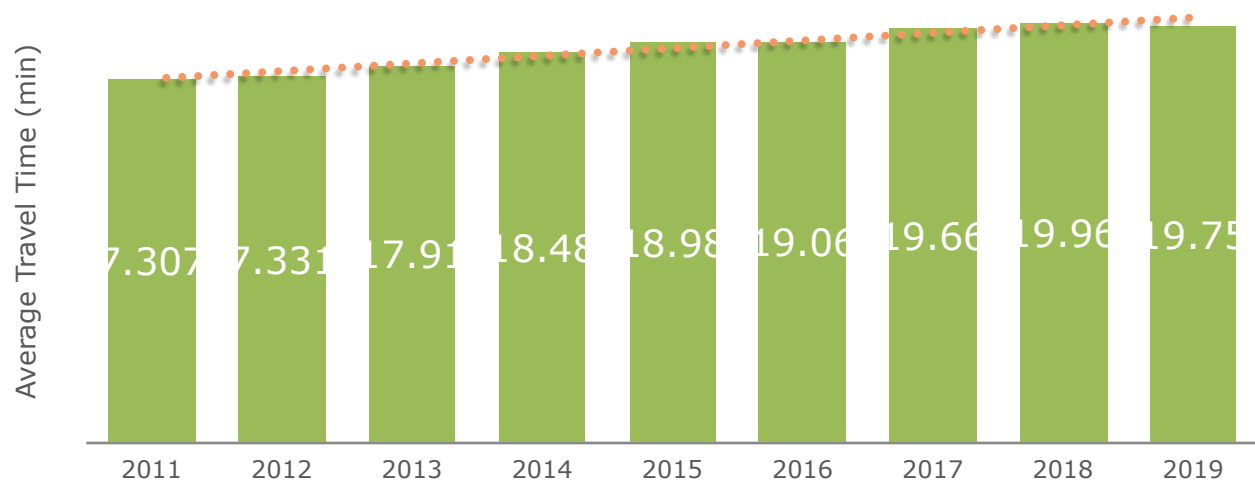### SR 143 at Sky Harbor Blvd to US 60 at Val Vista Dr

*Corridor 3*
# I-10 to US 60: I-10 at 7th Street to US 60 at Loop 101 (Price)



## I-10 to US 60: Eastbound - PM
## I-10 at 7th St to US 60 at Loop 101



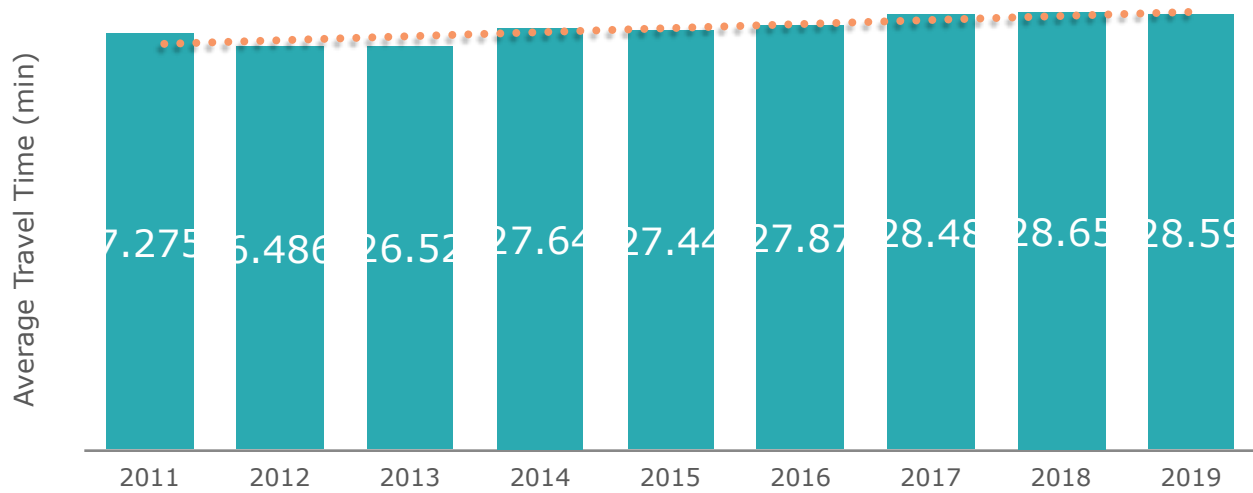| Year | Average Travel Time (min) |
|------|---------------------------|
| 2011 | 7.307 |
| 2012 | 7.331 |
| 2013 | 17.91 |
| 2014 | 18.48 |
| 2015 | 18.98 |
| 2016 | 19.06 |
| 2017 | 19.66 |
| 2018 | 19.96 |
| 2019 | 19.75 |
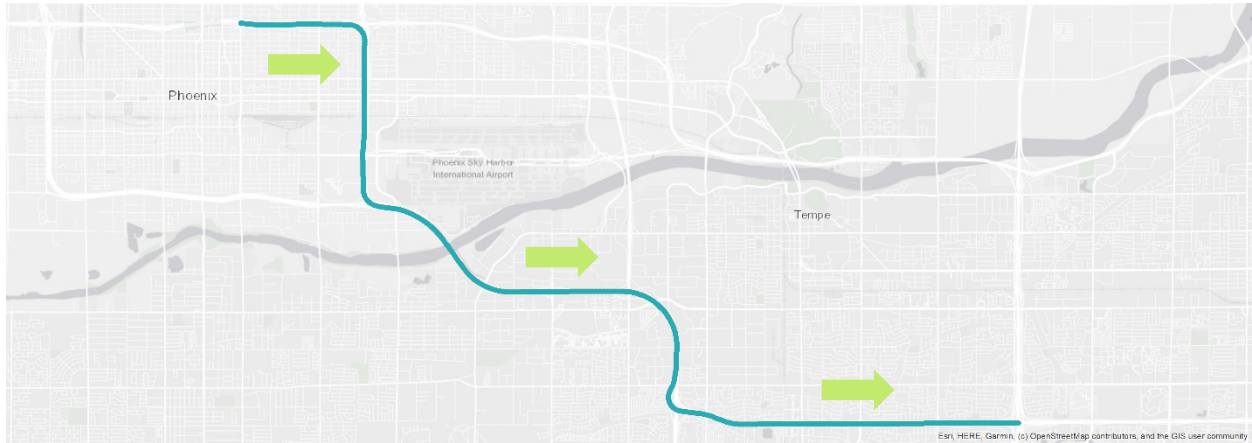
*Corridor 4*

Loop 101 (Price) to I-17:  Loop 101 (Price) at Guadalupe Road to I-17 at Dunlap Avenue
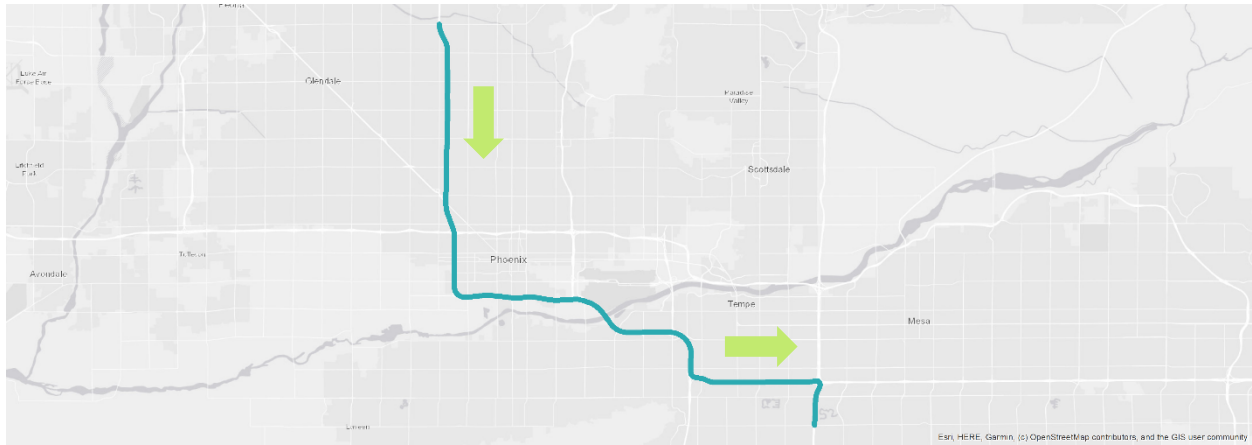


### Loop 101 (Price) to US 60 to I-10 to I-17: Westbound/Northbound - AM
### Loop 101 (Price) at Guadalupe Rd to I-17 at Dunlap Ave



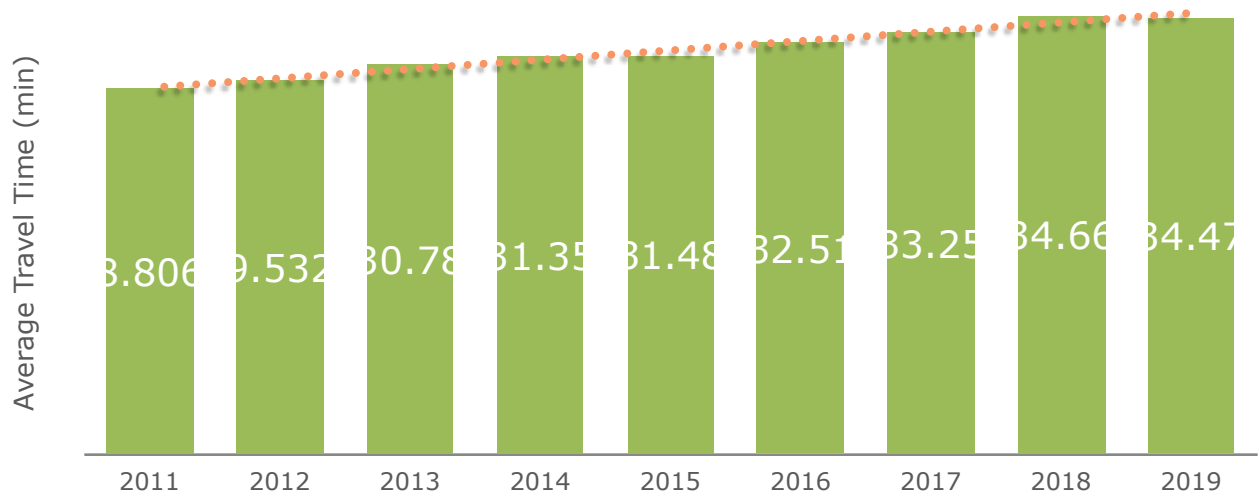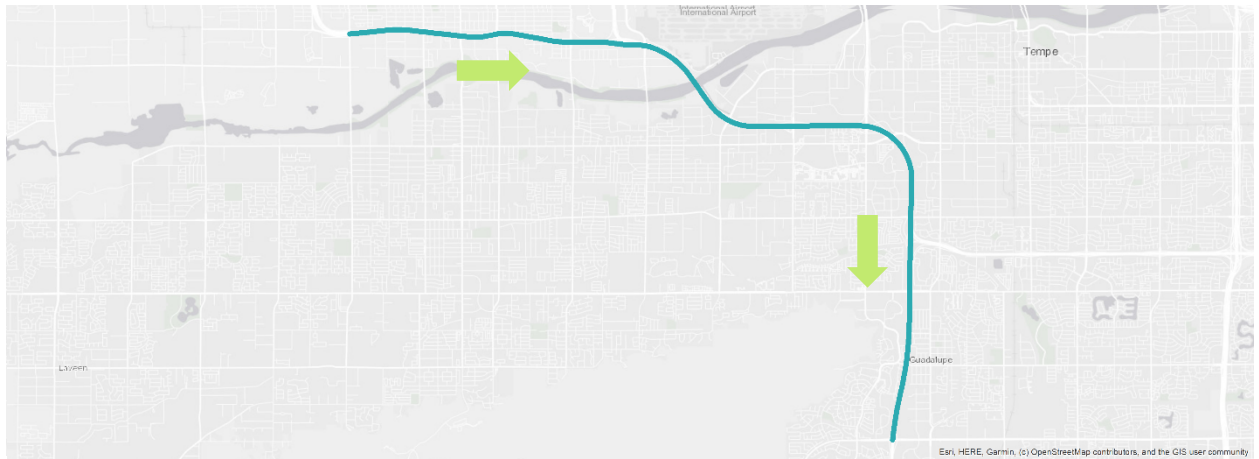| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| Average Travel Time (min) | 7.275 | 6.486 | 26.52 | 27.64 | 27.44 | 27.87 | 28.48 | 28.65 | 28.59 |

### Loop 101 (Price) to US 60 to I-10 to I-17: Westbound/Northbound - PM
### Loop 101 (Price) at Guadalupe Rd to I-17 at Dunlap Ave



Average Travel Time (min)

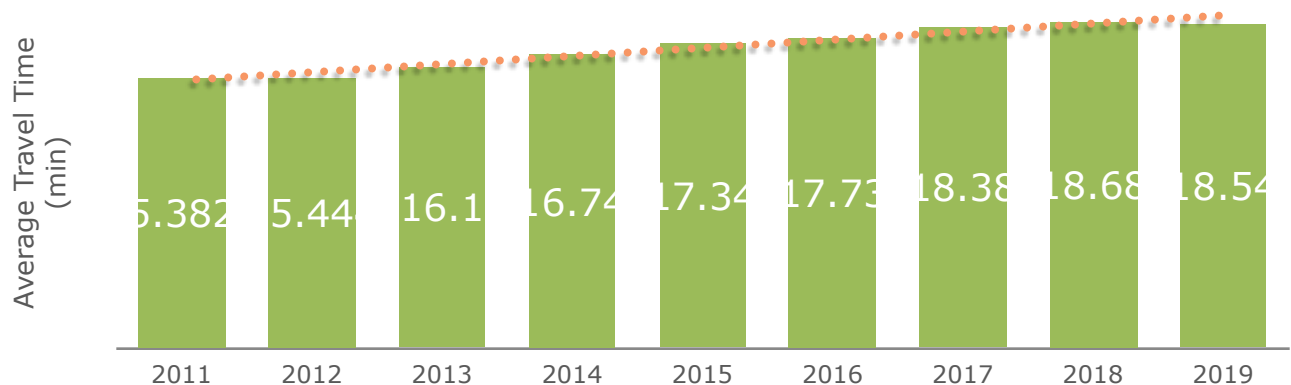| Year | Value |
|------|-------|
| 2011 | 8.806 |
| 2012 | 9.532 |
| 2013 | 30.78 |
| 2014 | 31.35 |
| 2015 | 31.48 |
| 2016 | 32.51 |
| 2017 | 33.25 |
| 2018 | 34.66 |
| 2019 | 34.47 |

*Corridor 5*

## I-17 to I-10: I-17 at 19th Avenue to I-10 at Elliot Road



### I-17 to I-10: Southbound - PM
### I-17 at 19th Ave to I-10 at Elliot Rd



Average Travel Time (min)

| Year | Value |
|------|-------|
| 2011 | 5.382 |
| 2012 | 5.44 |
| 2013 | 16.1 |
| 2014 | 16.74 |
| 2015 | 17.34 |
| 2016 | 17.73 |
| 2017 | 18.38 |
| 2018 | 18.68 |
| 2019 | 18.54 |

*Corridor 6*

## SR 143 to I-10: SR 143 at University Boulevard to I-10 at Warner Road
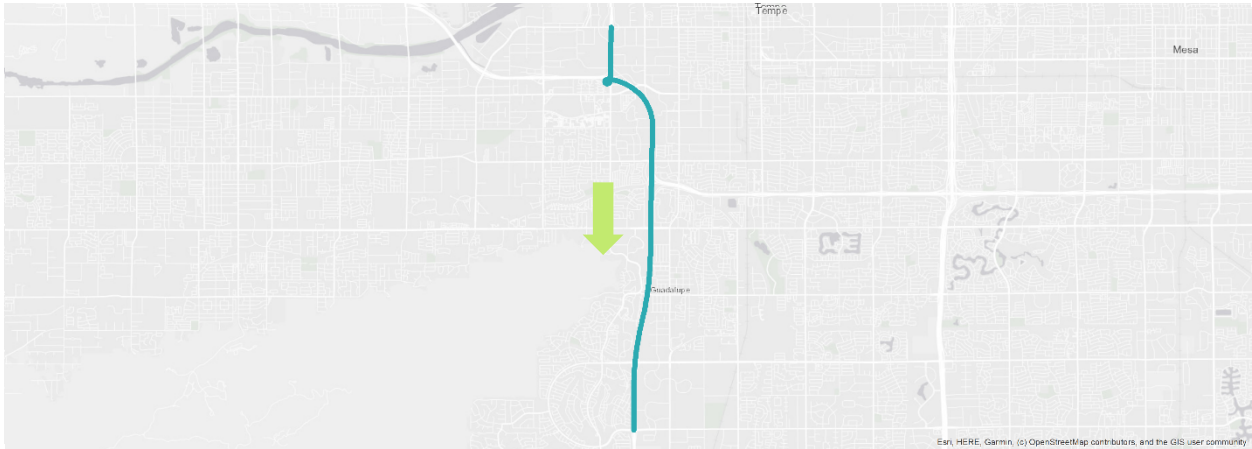


### SR 143 to I-10: Southbound - PM
### SR 143 at University Blvd to I-10 at Warner Rd



| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| Average Travel Time (min) | .885 | .832 | 9.2 | 9.85 | 10.01 | 10.38 | 10.96 | 11.19 | 11.06 |
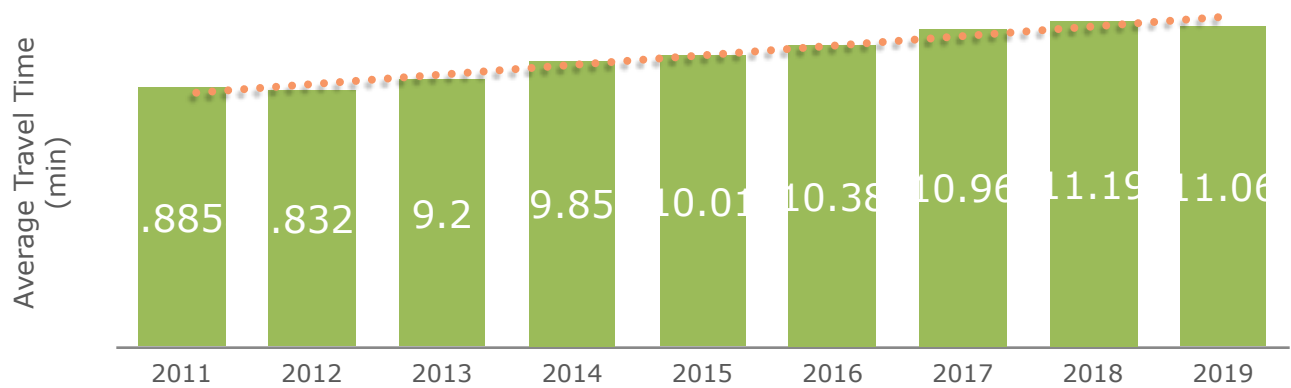
*Corridor 7*
## I-10 to SR 51: I-10 at 83rd Avenue to SR 51 at Bell Road
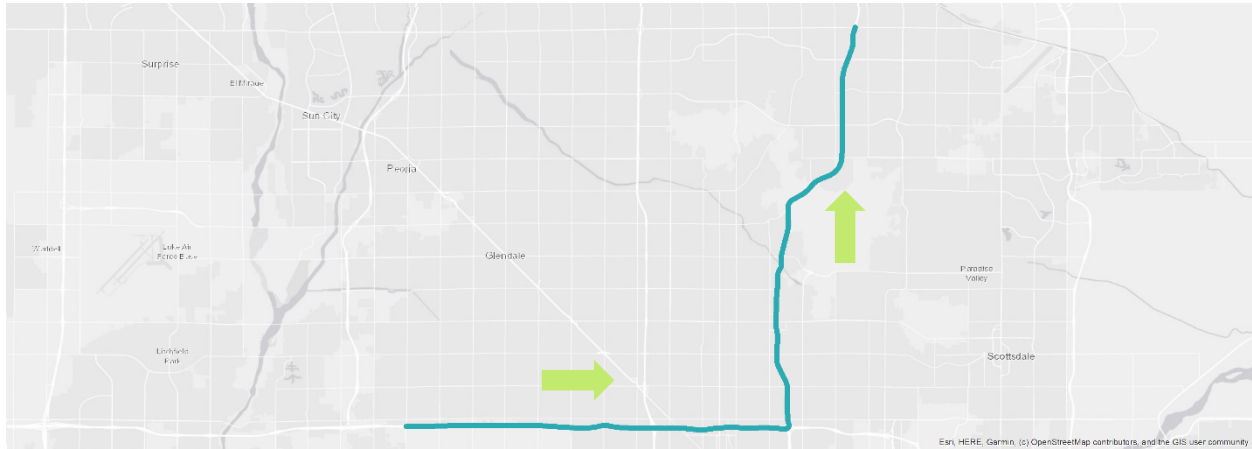


### I-10 to SR 51: Eastbound/Northbound - PM
### I-10 at 83rd Ave to SR 51 at Bell Rd
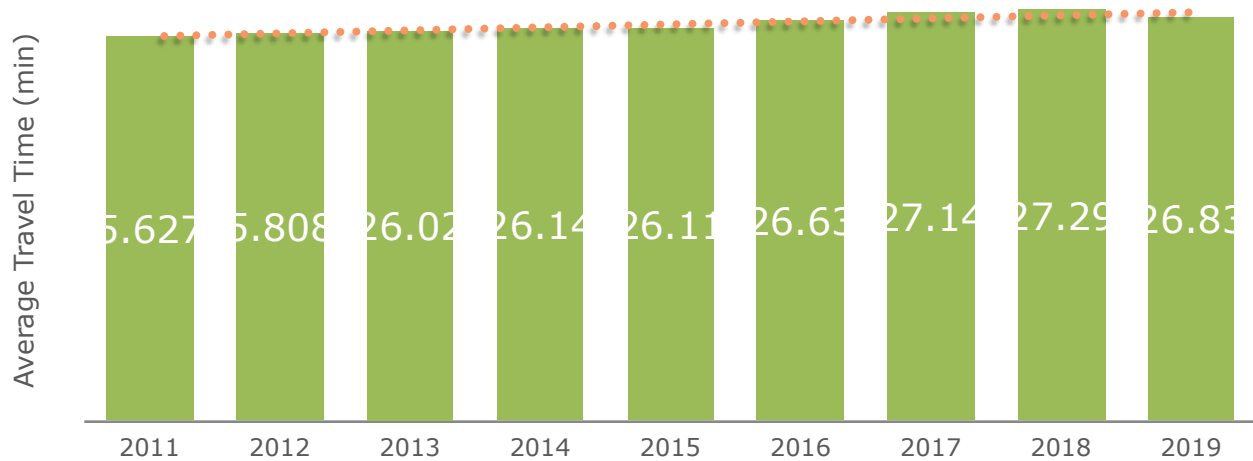
*Corridor 8*

Loop 101: Loop 101 (Price) at US 60 to Loop 101 (Pima) at Frank Lloyd Wright Boulevard

## Loop 101: Northbound - AM
### Loop 101 (Price) at US 60 to Loop 101 (Pima) at Frank Lloyd Wright Blvd



| 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|
| 8.648 | 7.963 | 18.29 | 19.67 | 19.12 | 18.15 | 17.63 | 17.92 | 18.01 |

## Loop 101: Northbound - PM
### Loop 101 (Price) at US 60 to Loop 101 (Pima) at Frank Lloyd Wright Blvd



| 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|
| 5.528 | 6.599 | 16.66 | 16.87 | 16.74 | 16.19 | 15.91 | 15.89 | 15.93 |
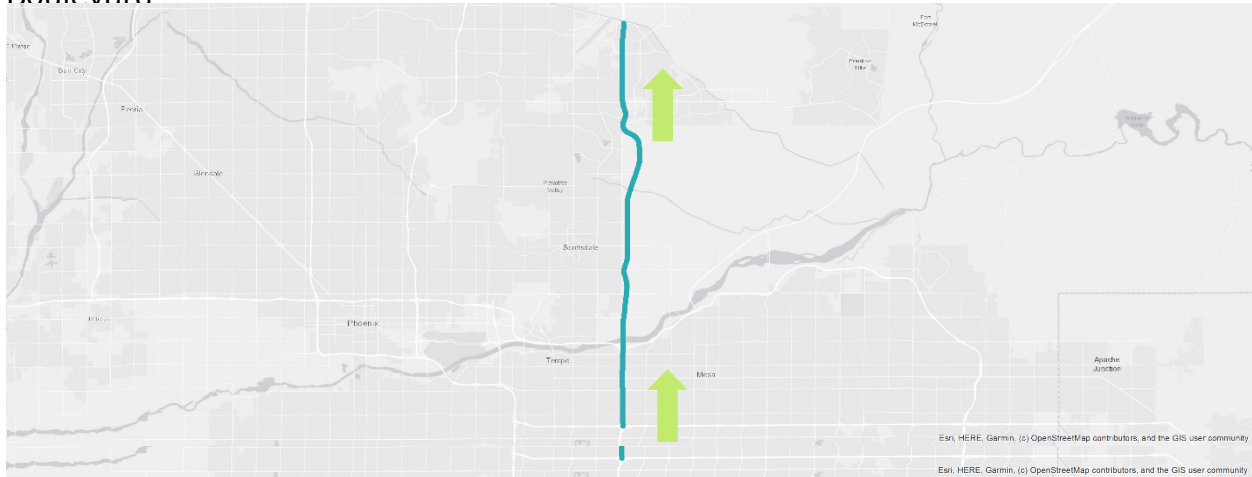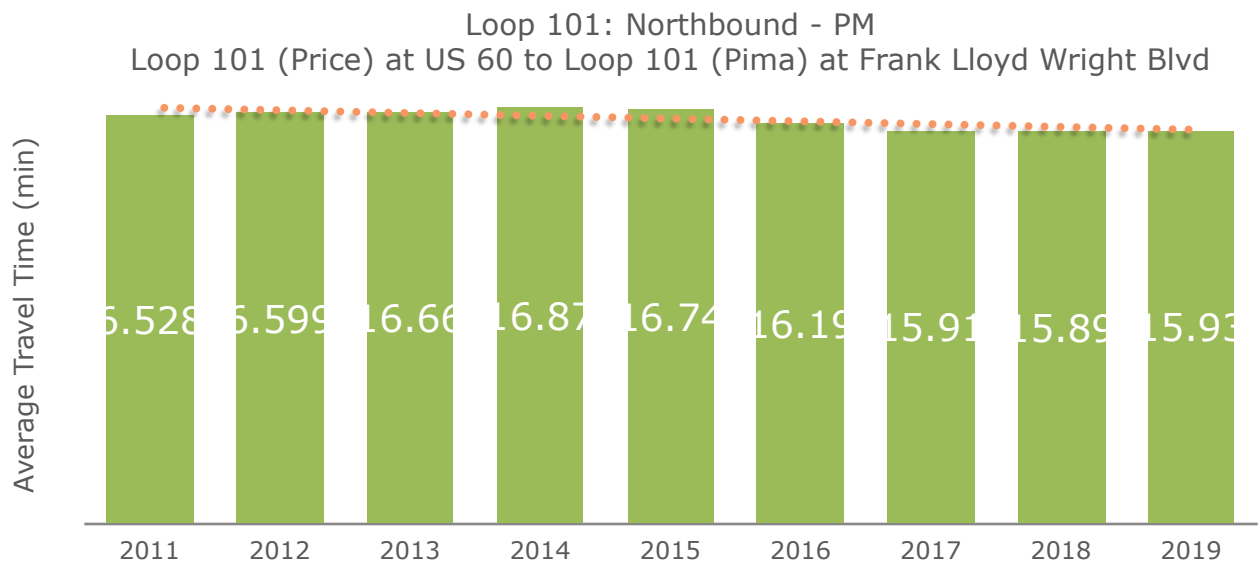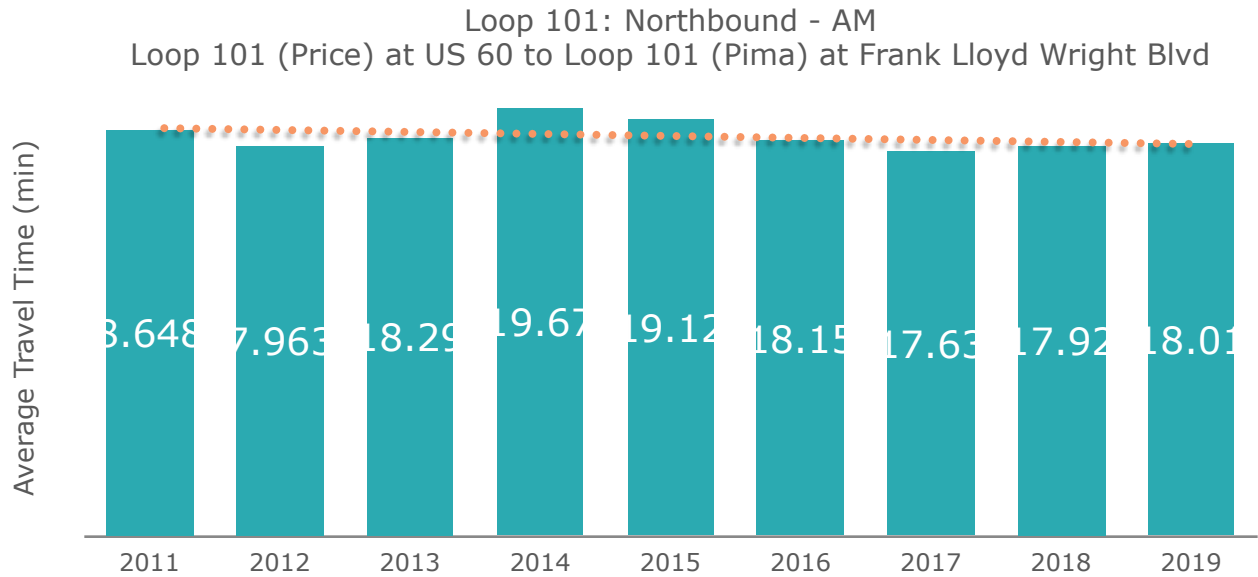
## Non-motorized Performance

While MAG strives to evaluate performance on all modes of transportation, there is currently a lack of data available to meaningfully report about non-motorized modes beyond the growth of infrastructure.

## Project-Level Prioritization and Analysis

Evaluating, prioritizing, and analyzing projects is essential and foundational work at a metropolitan planning organization. MAG uses a variety of tools, data, and techniques to examine projects through a variety of lenses. Starting in 2008, MAG develop a spreadsheet-based analysis tool as part of its Congestion Management Process. The tool served as the foundation for modal call for projects and was modified as needed to suit the analysis required.

Click here for more information on the Congestion Management Process

Recently, MAG has completed work on an interactive online platform to automate the analysis and processing of much of the data required for a performance-based prioritization effort. The Arterial and Bridge Needs Research created platform also allows users to search, filter and query the underlying datasets and provides regional context to the scores provided.

Click here for more information on the Arterial and Bridge Needs Research Platform

MAG continues to research and develop criteria and methodology to ensure best practices in project-level prioritization and evaluation are being utilized across the agency.

# Future of the Program

The Transportation Performance Program will continue to collaborate on MAG's next RTP, known as MOMENTUM. As MAG looks towards a holistic approach to project development selection and programming, the program will continue to provide a vital connection in the process.

In addition to maintaining and setting federal performance targets, the program is also responsible for the evaluation of projects. This important work faces several challenges. Coordination with other programs to ensure project-specific data is available will continue to be a focus of the program, as will creating a central repository for transportation-specific data that will improve our ability to manage and access datasets from across the agency. Continuing to carefully curate the balance between quantitative and qualitative inputs in project selection remains among the highest priorities and greatest challenges for the program.

Emerging datasets and the advancement of data collection techniques will continue to advance the state of the practice. The Transportation Performance Program strives to evaluate and integrate new technologies whenever possible.

# Appendix A – State & Federal Guidance

View complete texts and more information about relevant federal and state statutes by browsing the links below:

## Proposition 400

Title 28 – Transportation
AZ Rev Stat § 42-6105 – County Transportation Excise Tax
AZ Rev Stat § 28-6303 – Regional Area Road Fund; Separate Accounts
AZ Rev Stat § 48-5103 – Public Transportation Fund
AZ Rev Stat § 28-6354 – Annual Report; Hearing; Priority Criteria

## Federal Performance Measures

23 CFR 450.306: Scope of the metropolitan planning process
23 CFR 450.322: Congestion management process in transportation management areas
23 CFR 450. 324: Development and content of the metropolitan transportation plan
23 USC 119: National highway performance program
23 USC 134: Metropolitan transportation planning
23 USC 135: Statewide and nonmetropolitan transportation planning
23 USC 148: Highway safety improvement program
23 USC 149: Congestion mitigation and air quality improvement program
23 USC 150: National goals and performance management measures
23 USC 167: National highway freight program
23 USC 402: Highway safety programs
49 USC 5301: Policies and purposes
49 USC 5303: Metropolitan transportation planning
49 USC 5304: Statewide and nonmetropolitan transportation planning
49 USC 5310: Formula grants for the enhanced mobility of seniors and individuals with disabilities
49 USC 5326: Transit asset management
49 USC 5329: Public transportation safety program
49 USC 5335: National transit database
49 USC 70202: State freight plans

# Appendix B – Transportation Performance Data & Sources

The Transportation Performance Program relies on a wide variety of datasets produced at different governmental levels. The list below includes a brief description of the datasets, and. An attachment to this document provides clarity for each dataset that informs the measures produced by the program.

- **FHWA - Highway Performance Monitoring System (HPMS)** - The HPMS is a national-level highway information system that includes data on the extent, condition, performance, use, and operating characteristics of the nation's highways. The HPMS contains administrative and extent of system information on all public roads, while information on other characteristics is represented in HPMS as a mix of universe and sample data for arterial and collector functional systems. Limited information on travel and paved miles is included in summary form for the lowest functional systems. HPMS was developed in 1978 as a continuing database, replacing the special biennial condition studies that had been conducted since 1965. The HPMS has been modified several times since its inception. Changes have been made to reflect changes in the highway systems, legislation, and national priorities, to reflect new technology, and to consolidate or streamline reporting requirements.[9]

- **ADOT - Freeway Management System (FMS)** – ADOT is one of the leading public agencies in the nation in the realm of Intelligent Transportation Systems and FMS. ADOT is taking advantage of the following intelligent infrastructure monitoring devices for management and operation of freeways[10]:

    - FMS devices in Phoenix region and Tucson area covering 490 directional miles of freeway

    - Over 415 data collection stations, collecting traffic data (i.e., flow, occupancy, speed) using various technologies

    - Over 360 ramp meters

    - A total of 208 dynamic message signs statewide to disseminate traffic, weather and advisory information to drivers on the road

    - A total of 284 closed-circuit televisions to monitor and verify incidents, as well as coordinate with the Department of Public Safety

    - Road Weather Information Systems at 17 sites

    - Wrong-Way Detection at 12 sites

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[9] https://www.fhwa.dot.gov/policyinformation/hpms.cfm. Accessed 8/30/2019.

[10] http://www.aztech.org/projects/adot-fms.htm. Accessed 8/30/2019

- ○ Travel time displays in the Metro Phoenix and Metro Tucson areas on 82 dynamic message signs

- **FHWA - National Performance Management Research Data Set -** FHWA has acquired a second (v2) national data set of average travel times on the NHS for use in its performance measures and management activities. This data set is also available to State Departments of Transportation and Metropolitan Planning Organizations to use for their performance management activities. The dataset will be available monthly.[11]

- **University of Maryland's CATT Lab via FHWA Contract – Regional Integrated Transportation Information System (RITIS)** – RITIS is a situational awareness, data archiving, and analytics platform used by transportation officials, first responders, planners, and researchers, among others and more. RITIS fuses data from many agencies, many systems, and even the private sector—enabling effective decision-making for incident response and planning. Within RITIS are a broad portfolio of analytical tools and features. Ultimately, RITIS enables a wide range of capabilities and insights, reduces the cost of planning activities and conducting research, and breaks down the barriers within and between agencies for information sharing, collaboration, and coordination.[12]

- **ADOT – Accident Location Identification Surveillance System (ALISS)** – ALISS is a crash data archive for ADOT. The primary source of data for this database is the State Highway Log system. The data is not "real time"[13].

- **HERE Data** – HERE captures location content such as road networks, buildings, parks and traffic patterns. It then sells or licenses that mapping content, along with navigation services and location solutions to other businesses such as Alpine, Garmin, BMW, Oracle, and Amazon.com. In addition, HERE provides platform services to smartphones. It provides location services through its own HERE applications, and also for GIS and government clients and other providers, such as Bing, Facebook, and Yahoo! Maps.[14]

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[11] https://ops.fhwa.dot.gov/perf_measurement/index.htm. Accessed 8/30/2019.

[12] https://ritis.org/intro. Accessed 8/30/2019.

[13] https://apps.azdot.gov/files/its-architecture/html/inv/el274.htm Accessed 2/3/2020.

[14] https://en.wikipedia.org/wiki/Here_(company). Accessed 9/16/2019

# Appendix C – History of Performance Measures at MAG

The process of creating the Performance Management Program at MAG began in 2008 with the development of the Performance Measurement Framework and Congestion Management Update Study. The program was formally initiated in 2009 with the participation of MAG Member Agency modal committee representatives, as well as RTP partners including ADOT and Valley Metro/Regional Public Transit Authority. The intention of the program has been to provide a functional component that links planning and programming activities, using performance data and analysis. This process would introduce enhanced transparency and accountability, improving the quality of transportation investment decisions.

Beginning in 2010, the MAG Performance Management Program began analyzing and reporting on observed speed and volume data reported by ADOT's FMS. These data are collected by a series of detectors including passive acoustic detectors and loop detectors which are embedded in the roadway. These reported data allow MAG to calculate and report on throughput, speed, lost productivity, and extent and duration of congestion. Due to the data collection methods, FMS data is provided for all individual lanes, including high occupancy vehicle facilities.

Starting in 2011, MAG began obtaining speed data from a private sector provider NAVTEQ (later re-named HERE). These speed-only data sets were/are obtained by Bluetooth detectors that connect to Bluetooth enabled vehicles and devices. Due to the inclusive nature of this detection process, these data provide full coverage of data for both the freeway and major arterial networks. Measures calculated from these data sets include speed, delay, congestion, Planning Time Index, and Travel Time Index. Unlike ADOT FMS data, the collection methods for these data do not allow for reporting on individual traffic lanes.

Beginning in 2012 with the Moving Ahead for Progress in the 21st Century Act (MAP-21) and continuing in 2015 with the Fixing America's Surface Transportation Act (FAST Act), the federal government has established rules for measuring performance and setting future targets on a system-level for states and MPOs.

Born from the Congestion Management Update Study, the Congestion Management Process (CMP) tool was designed to complement existing processes. The CMP tool was built to consider RTP goals and objectives, and to score and rank projects accordingly. The base tool used both quantitative and qualitative criteria in its prioritization process and has since been customized to the specific eligibility and funding requirements of various modal programs. To date, specific tools have been created to help program ALCP project changes, as well as project selections for the Pinal County Arterial and Bridge Program, Active Transportation Program, and Systems Management and Operations Program.

# Appendix D – Comparative Analysis Hyperlinks

PM3 Targets for PSRC (Seattle), WFRC (Salt Lake City), SANDAG (San Diego) and RTC (Las Vegas) were not available on their websites.

DRCOG, SCAG and SACOG all supported the statewide targets, while NCTCOG and H-GAC had distinct targets calculated by TxDOT.

TTR Interstate and non-Interstate NHS:

- DRCOG
  - The DRCOG Board elected to support CDOT's performance targets related to TTR.
- SCAG
  - SCAG opted to adopt the statewide targets for their region.
- NCTCOG
  - Adopted its own 2020 and 2022 targets for these measures.
- H-GAC
  - TxDOT partnered with the TTI to establish a statewide methodology and recommend future year targets for all MPOs within Texas. TTI calculated the base-year measurements from observed data and formulated targets for the H-GAC region.
- SACOG
  - SACOG supports meeting the statewide targets.

Freight Reliability:

- DRCOG
  - The DRCOG Board elected to support CDOT's performance targets related to freight reliability.
- SCAG
  - SCAG opted to adopt the statewide targets for our region.
- NCTCOG
  - Adopted its own 2020 and 2022 targets for these measures.
- H-GAC
  - TxDOT partnered with the TTI to establish a statewide methodology and recommend future year targets for all MPOs within Texas. TTI

calculated the base-year measurements from observed data and formulated targets for the H-GAC region.

- SACOG

  - SACOG supports meeting the statewide targets.

Traffic Congestion Reduction:

- DRCOG

  - Completed jointly with CDOT, the DRCOG Board and CDOT Transportation Commission established the performance targets.

- SCAG

  - Caltrans & SCAG coordinate on a single, unified 2-year & 4-year target. Different targets were developed for the Los Angeles-Long Beach-Anaheim Urban Area and the Riverside-San Bernardino Urban Area.

- NCTCOG

  - Adopted its own 2020 and 2022 targets for these measures

- H-GAC

  - TxDOT partnered with the TTI to establish a statewide methodology and recommend future year targets for all MPOs within Texas. TTI calculated the base-year measurements from observed data and formulate targets for the H-GAC region.

- SACOG

  - SACOG supports meeting the statewide targets.